ASTRONOMICAL PHENOMENA

FOR THE YEAR

2017

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The Nautical Almanac Office
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PREDICTED PERIHELION PASSAGES OF COMETS, 2017

Periodic comet	Perihelion date T	distance q(au)	Period P(yr)
128P/Shoemaker-Holt	Jan. 10	3·06	9·6
P/2013 YG46 (Spacewatch)	Jan. 29	1·79	5·9
P/2003 SQ215 (NEAT-LONEOS)	Feb. 2	2·28	12·8
P/2006 G1 (McNaught)	Feb. 3	2·78	11·3
P/2007 T6 (Catalina)	Feb. 15	2·22	9·5
188P/LINEAR-Mueller	Feb. 17	2·57	9·2
219P/LINEAR	Feb. 20	2·37	7·0
93P/Lovas	Mar. 1	1·70	9·2
2P/Encke	Mar. 10	0·34	3·3
176P/LINEAR	Mar. 12	2·58	5·7
172P/Yeung	Mar. 13	3·34	8·6
73P/Schwassmann-Wachmann	Mar. 16	0·97	5·4
182P/LONEOS	Apr. 11	1·01	5·1
41P/Tuttle-Giacobini-Kresák	Apr. 13	1·05	5·4
54P/de Vico-Swift-NEAT	Apr. 15	2·18	7·4
103P/Hartley	Apr. 20	1·07	6·5
255P/Levy	May 3	1·01	5·3
P/2001 F1 (NEAT)	May 5	4·18	16·7
229P/Gibbs	May 20	2·46	7·8
234P/LINEAR	June 1	2·85	7·4
47P/Ashbrook-Jackson	June 10	2·82	8·4
P/1999 XN120 (Catalina)	June 12	3·30	8·6
90P/Gehrels	June 19	2·98	14·9
227P/Catalina-LINEAR	June 22	1·79	6·8
P/2000 S1 (Skiff)	June 24	2·54	17·1
71P/Clark	June 30	1·59	5·6
P/2013 P5 (PANSTARRS)	July 10	1·94	3·2
251P/LINEAR	July 16	1·73	6·6
217P/LINEAR	July 16	1·24	7·9
259P/Garradd	Aug. 4	1·81	4·5
189P/NEAT	Aug. 5	1·21	5·1
P/2010 P4 (WISE)	Aug. 18	1·86	7·1
30P/Reinmuth	Aug. 19	1·88	7·3
145P/Shoemaker-Levy	Aug. 31	1·90	8·4
P/2010 H2 (Vales)	Sept. 15	3·10	7·5
213P/Van Ness	Sept. 24	1·98	6·1
263P/Gibbs	Sept. 29	1·26	5·4
P/2004 T1 (LINEAR-NEAT)	Oct. 13	1·72	6·5
65P/Gunn	Oct. 16	2·91	7·6
96P/Machholz	Oct. 27	0·12	5·3
183P/Korlević-Jurić	Nov. 11	3·87	9·5
62P/Tsuchinshan	Nov. 16	1·38	6·4
24P/Schaumasse	Nov. 16	1·21	8·3
236P/LINEAR	Nov. 20	1·84	7·2
14P/Wolf	Dec. 1	2·74	8·8
139P/Väisälä-Oterma	Dec. 10	3·41	9·6
P/2010 D1 (WISE)	Dec. 18	2·69	8·5
P/2009 S2 (McNaught)	Dec. 21	2·21	8·5

The astronomical data in this booklet are expressed in the scale of universal time (UT); this is also known as Greenwich mean time (GMT) and is the standard time of the Greenwich meridian (0° of longitude). A time in UT may be converted to local mean time by the addition of east longitude (or subtraction of west longitude), where the longitude of the place is expressed in time-measure at the rate of 1 hour for every 15°. The differences between standard times and UT are indicated in the chart on page 22; local clock times may, however, differ from these standard times, especially in summer when clocks are often advanced by 1 hour.

PRINCIPAL PHENOMENA OF SUN AND MOON, 2017

THE SUN

		d	h				d	h	m				d	h	m
Perigee	... Jan.	4	14	Equinoxes	... Mar.	20	10	29	...	... Sept.	22	20	02
Apogee	... July	3	20	Solstices	... June	21	04	24	...	... Dec.	21	16	28

PHASES OF THE MOON

Lunation	New Moon				First Quarter				Full Moon				Last Quarter			
		d	h	m		d	h	m		d	h	m		d	h	m
1163					Jan.	5	19	47	Jan.	12	11	34	Jan.	19	22	13
1164	Jan.	28	00	07	Feb.	4	04	19	Feb.	11	00	33	Feb.	18	19	33
1165	Feb.	26	14	58	Mar.	5	11	32	Mar.	12	14	54	Mar.	20	15	58
1166	Mar.	28	02	57	Apr.	3	18	39	Apr.	11	06	08	Apr.	19	09	57
1167	Apr.	26	12	16	May	3	02	47	May	10	21	42	May	19	00	33
1168	May	25	19	44	June	1	12	42	June	9	13	10	June	17	11	33
1169	June	24	02	31	July	1	00	51	July	9	04	07	July	16	19	26
1170	July	23	09	46	July	30	15	23	Aug.	7	18	11	Aug.	15	01	15
1171	Aug.	21	18	30	Aug.	29	08	13	Sept.	6	07	03	Sept.	13	06	25
1172	Sept.	20	05	30	Sept.	28	02	54	Oct.	5	18	40	Oct.	12	12	25
1173	Oct.	19	19	12	Oct.	27	22	22	Nov.	4	05	23	Nov.	10	20	36
1174	Nov.	18	11	42	Nov.	26	17	03	Dec.	3	15	47	Dec.	10	07	51
1175	Dec.	18	06	30	Dec.	26	09	20								

ECLIPSES

A penumbral eclipse of the Moon	Feb. 10-11	Western Asia, Africa, Europe, Greenland, South America, North America and parts of the Pacific Ocean.
An annular eclipse of the Sun	Feb. 26	S.E. Pacific Ocean, S. half of S. America, most of Antarctica, Africa (except northern parts).
A partial eclipse of the Moon	Aug. 7	Western Pacific Ocean, Oceania, Australasia, Asia, Africa, Europe, easternmost tip of South America.
A total eclipse of the Sun	Aug. 21	Hawaii, N.E. Pacific Ocean, North America, Central America, northern parts of South America, westernmost tip of Europe and W. Africa.

For further details see pages 64–81

MOON AT PERIGEE

	d	h		d	h		d	h
Jan.	10	06	May	26	01	Oct.	9	06
Feb.	6	14	June	23	11	Nov.	6	00
Mar.	3	08	July	21	17	Dec.	4	09
Mar.	30	13	Aug.	18	13			
Apr.	27	16	Sept.	13	16			

MOON AT APOGEE

	d	h		d	h		d	h
Jan.	22	00	June	8	22	Oct.	25	02
Feb.	18	21	July	6	04	Nov.	21	19
Mar.	18	17	Aug.	2	18	Dec.	19	01
Apr.	15	10	Aug.	30	11			
May	12	20	Sept.	27	07			

OCCULTATIONS OF PLANETS AND BRIGHT STARS BY THE MOON

Date	d	h	Body	Areas of Visibility
Jan.	3	04	Neptune	Most of S.E. Asia, Micronesia, Hawaii, west coast of N. America
Jan.	3	07	Mars	S. tip of India, most of S.E. Asia, Micronesia
Jan.	9	15	*Aldebaran*	N.E. Africa, Arabia, India, China, Japan
Jan.	15	05	*Regulus*	S. half of S. America, Antarctic Peninsula
Jan.	30	11	Neptune	Ascension I., Central Africa, S. Arabia, India, W. China, Thailand
Feb.	3	02	Ceres	E. Siberia, Alaska, N. Canada, Greenland
Feb.	5	22	*Aldebaran*	Central America, N. South America, Caribbean, N. Africa, S. Europe, W. Middle East
Feb.	11	14	*Regulus*	Australia, Wilkes Land, New Zealand
Mar.	2	21	Ceres	S. half of South America, Antarctic Peninsula, South Georgia
Mar.	5	03	*Aldebaran*	Soloman Is., Micronesia, Hawaii, N. and Central America, W. Caribbean
Mar.	10	23	*Regulus*	S.E. South America, S. Georgia, Queen Maud Land, S. tip of S. Africa
Mar.	26	08	Neptune	Ascension I., S. Africa, N. Madagascar, Yemen, Oman, S.W. Asia
Apr.	1	09	*Aldebaran*	N.E. Africa, Arabia, India, Mongolia, China, Japan
Apr.	7	05	*Regulus*	S. Polynesia, Antarctic Peninsula, S. tip of S. America
Apr.	22	20	Neptune	Most of Australia, New Zealand, S.E. Melanesia, Central Polynesia
Apr.	24	16	Pallas	Most of N. America, Greenland, Iceland, Ireland
Apr.	28	18	*Aldebaran*	N. America, Cuba, E. Canada, S. tip of Greenland, Europe, N. Africa
May	4	10	*Regulus*	Indonesia, Malaysia, S. New Guinea, Australia, New Zealand
May	20	06	Neptune	Falkland Is., S. part of Africa, Madagascar, Maldives
May	31	17	*Regulus*	E. Brazil, Cape Verde Is., Central and S. Africa excluding S. tip, Mauritius
June	16	13	Neptune	Western Antarctica, S. half of South America
June	22	15	*Aldebaran*	Most of N. America, S. Greenland, Azores, most of Europe, N.W. part of Africa
June	28	01	*Regulus*	Micronesia, Hawaii, Galapagos Is., Peru, Ecuador
July	13	18	Neptune	Most of Antarctica, New Zealand, Chatham I.
July	20	00	*Aldebaran*	India, Central and N.E. Asia, Aleutian Is., Hawaii
July	25	09	Mercury	N. Europe including British Isles, most of Greenland, N. half of Asia
July	25	11	*Regulus*	N. half of Africa, Middle East, S. India, Indonesia
Aug.	9	23	Neptune	Most of Antarctica, Kerguelen Is., W. tip of Australia
Aug.	16	07	*Aldebaran*	N. tip of S. America, Caribbean, northernmost Africa, Europe, Middle East, W. Asia
Sept.	6	05	Neptune	Most of Antarctica, S.E. South America, South Georgia
Sept.	12	13	*Aldebaran*	Hawaii, Central most of North America, Azores
Sept.	18	01	Venus	S.E. Asia, Australia, New Zealand
Sept.	18	05	*Regulus*	N.E. Africa, Middle East, S.E. Asia, N. Australia
Sept.	18	20	Mars	N.E. Micronesia, Hawaii, Galapagos Is., N.W. South America
Sept.	18	23	Mercury	Easternmost Asia, Micronesia, N. Polynesia
Oct.	3	12	Neptune	Kerguelen Is., most of Antarctica, S.E. tip of Australia, New Zealand, S.W. Polynesia.

continued on page 14 . . .

GEOCENTRIC PHENOMENA

MERCURY

		d h		d h		d h		d h
Stationary	Jan.	8 10	May	2 14	Sept.	4 16	Dec.	23 03
Greatest elongation West	Jan.	19 10 (24°)	May	17 23 (26°)	Sept.	12 10 (18°)		—
Superior conjunction	Mar.	7 00	June	21 14	Oct.	8 21		—
Greatest elongation East	Apr.	1 10 (19°)	July	30 05 (27°)	Nov.	24 00 (22°)		—
Stationary	Apr.	10 01	Aug.	12 06	Dec.	3 08		—
Inferior conjunction	Apr.	20 06	Aug.	26 21	Dec.	13 02		—

VENUS

		d h		d h
Greatest elongation East	Jan.	12 13 (47°)	Stationary	Apr. 13 00
Greatest illuminated extent	Feb.	17 07	Greatest illuminated extent	Apr. 30 04
Stationary	Mar.	2 14	Greatest elongation West	June 3 13 (46°)
Inferior conjunction	Mar.	25 10		

EARTH

		d h			d h m			d h m
Perihelion	Jan.	4 14	Equinoxes	Mar.	20 10 29		Sept.	22 20 02
Aphelion	July	3 20	Solstices	June	21 04 24		Dec.	21 16 28

SUPERIOR PLANETS

	Conjunction		Stationary		Opposition		Stationary	
		d h		d h		d h		d h
Mars	July	27 01		—		—		—
Jupiter	Oct.	26 18	Feb.	6 19	Apr.	7 22	June	10 05
Saturn	Dec.	21 21	Apr.	6 05	June	15 10	Aug.	25 15
Uranus	Apr.	14 06	Aug.	3 10	Oct.	19 18		—
Neptune	Mar.	2 03	June	16 23	Sept.	5 05	Nov.	22 21

The vertical bars indicate where the dates for the planet are not in chronological order.

HELIOCENTRIC PHENOMENA

	Aphelion	Perihelion	Descending Node	Greatest Lat. South	Ascending Node	Greatest Lat. North
Mercury	Feb. 7	Mar. 23	Jan. 28	Feb. 27	Mar. 18	Jan. 4
	May 6	June 19	Apr. 26	May 26	June 14	Apr. 2
	Aug. 2	Sept. 15	July 23	Aug. 22	Sept. 10	June 29
	Oct. 29	Dec. 12	Oct. 19	Nov. 18	Dec. 7	Sept. 25
	—	—	—	—	—	Dec. 22
Venus	—	Feb. 20	May 9	July 5	Jan. 17	Mar. 14
	June 12	Oct. 3	Dec. 19	—	Aug. 30	Oct. 24
Mars	Oct. 7	—	—	—	Feb. 27	Aug. 30

Jupiter: Aphelion, Feb. 17
Saturn, Uranus, Neptune: None in 2017

VISIBILITY OF PLANETS

MERCURY can only be seen low in the east before sunrise, or low in the west after sunset (about the time of beginning or end of civil twilight). It is visible in the mornings between the following approximate dates: January 4 to February 24, April 29 to June 14, September 4 to September 28 and December 19 to December 31. The planet is brighter at the end of each period, (the best conditions in northern latitudes occur in mid-September and in late December and in southern latitudes in the second half of May). It is visible in the evenings between the following approximate dates: March 16 to April 12, June 29 to August 20 and October 23 to December 7. The planet is brighter at the beginning of each period,(the best conditions in northern latitudes occur from late March to early April and in southern latitudes from mid-July to mid-August).

VENUS is a brilliant object in the evening sky until in the second half of March when it becomes too close to the Sun for observation. It reappears in late March as a morning star and can be seen in the morning sky until late November when it again becomes too close to the Sun for observation. Venus is in conjunction with Mars on October 5 and with Jupiter on November 13.

MARS can be seen only in the evening sky until early June passing through Aquarius, Pisces from late January, into Aries in early March, Taurus in mid-April (passing 6° N of Aldebaran on May 7) and into Gemini in early June. From the start of the second week of June it becomes too close to the Sun for observation and reappears in the morning sky in mid-September in Leo, moves into Virgo in mid-October (passing 3° N of Spica on November 28) and then into Libra in late December. Mars is in conjunction with Mercury on September 16 and with Venus on October 5. The redddish tint of Mars should assist in its identification.

JUPITER can be seen in Virgo from the beginning of the year and from mid-January can be seen for more than half the night (passing 4° N of Spica on January 20 and again 4° N of Spica on February 23). It is at opposition on April 7 when it can be seen throughout the night. From early July it can only be seen in the evening sky (passing 3° N of Spica on September 5) and from mid-October it becomes too close to the Sun for observation. It reappears in the morning sky in the second week of November and passes into Libra in mid-November. Jupiter is in conjuction with Venus on November 13.

SATURN rises shortly before sunrise at the beginning of the year in Ophiucus, passing into Sagittarius in late February and can only be seen in the morning sky until mid-March. Its westward elongation gradually increases, passing into Ophiucus again in the second half of May, and is at opposition on June 15, when it can be seen throughout the night. Its eastward elongation gradually decreases, and from mid-September until early December it can only be seen in the evening sky. It returns into Sagittarius in mid-November and in early December it becomes too close to the Sun for observation for the remainder of the year. Saturn is in conjunction with Mercury on November 28.

URANUS is visible at the beginning of the year in Pisces and remains in this constellation throughout the year. From mid-January it can only be seen in the evening sky until late March when it becomes too close to the Sun for observation. It reappears in early May in the morning sky and is at opposition on Oct. 19. Its eastward elongation gradually decreases and Uranus can be seen for more than half the night.

NEPTUNE is visible at the beginning of the year in the evening sky in Aquarius and remains in this constellation throughout the year. In the second week of February it becomes too close to the Sun for observation and reappears in the second half of March in the morning sky. Neptune is at opposition on September 5 and from early December can only be seen in the evening sky.

DO NOT CONFUSE (1) Mercury with Mars in mid-September and with Saturn in late November to early December; on both occasions Mercury is the brighter object. (2) Venus with Mars in late September to mid-October and with Jupiter in mid-November; on both occasions Venus is the brighter object. (3) Mars with Jupiter in late December when Jupiter is the brighter object.

VISIBILITY OF PLANETS IN MORNING AND EVENING TWILIGHT

	Morning	Evening
Venus		January 1 – March 22
	March 30 – November 28	
Mars		January 1 – June 7
	September 12 – December 31	
Jupiter	January 1 – April 7	April 7 – October 13
	November 9 – December 31	
Saturn	January 1 – June 15	June 15 – December 5

VISIBILITY OF PLANETS

The planet diagram on page 9 shows, in graphical form for any date during the year, the local mean times of meridian passage of the Sun, of the five planets, Mercury, Venus, Mars, Jupiter and Saturn, and of every 2^h of right ascension. Intermediate lines, corresponding to particular stars, may be drawn in by the user if desired. The diagram is intended to provide a general picture of the availability of planets and stars for observation during the year.

On each side of the line marking the time of meridian passage of the Sun, a band 45^m wide is shaded to indicate that planets and most stars crossing the meridian within 45^m of the Sun are generally too close to the Sun for observation.

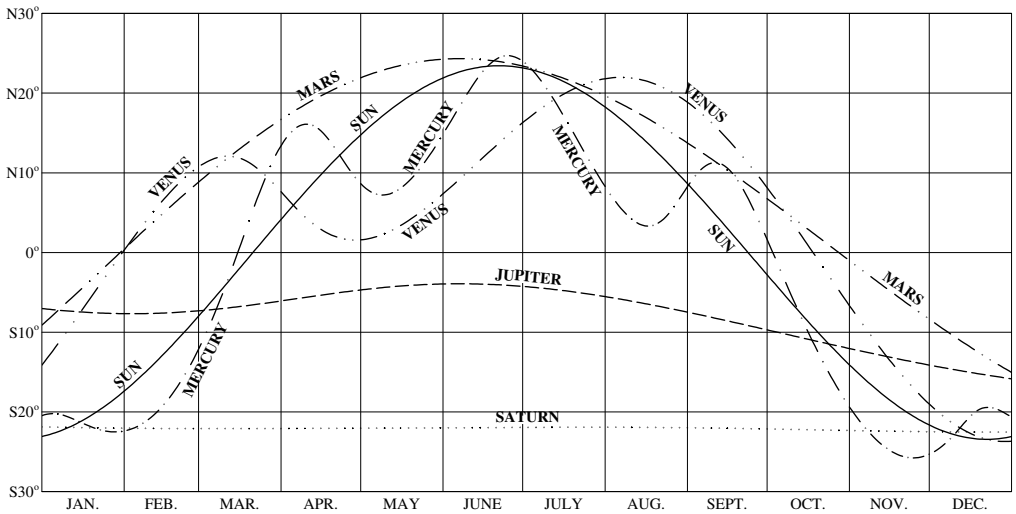
For any date the diagram provides immediately the local mean time of meridian passage of the Sun, planets and stars, and thus the following information:

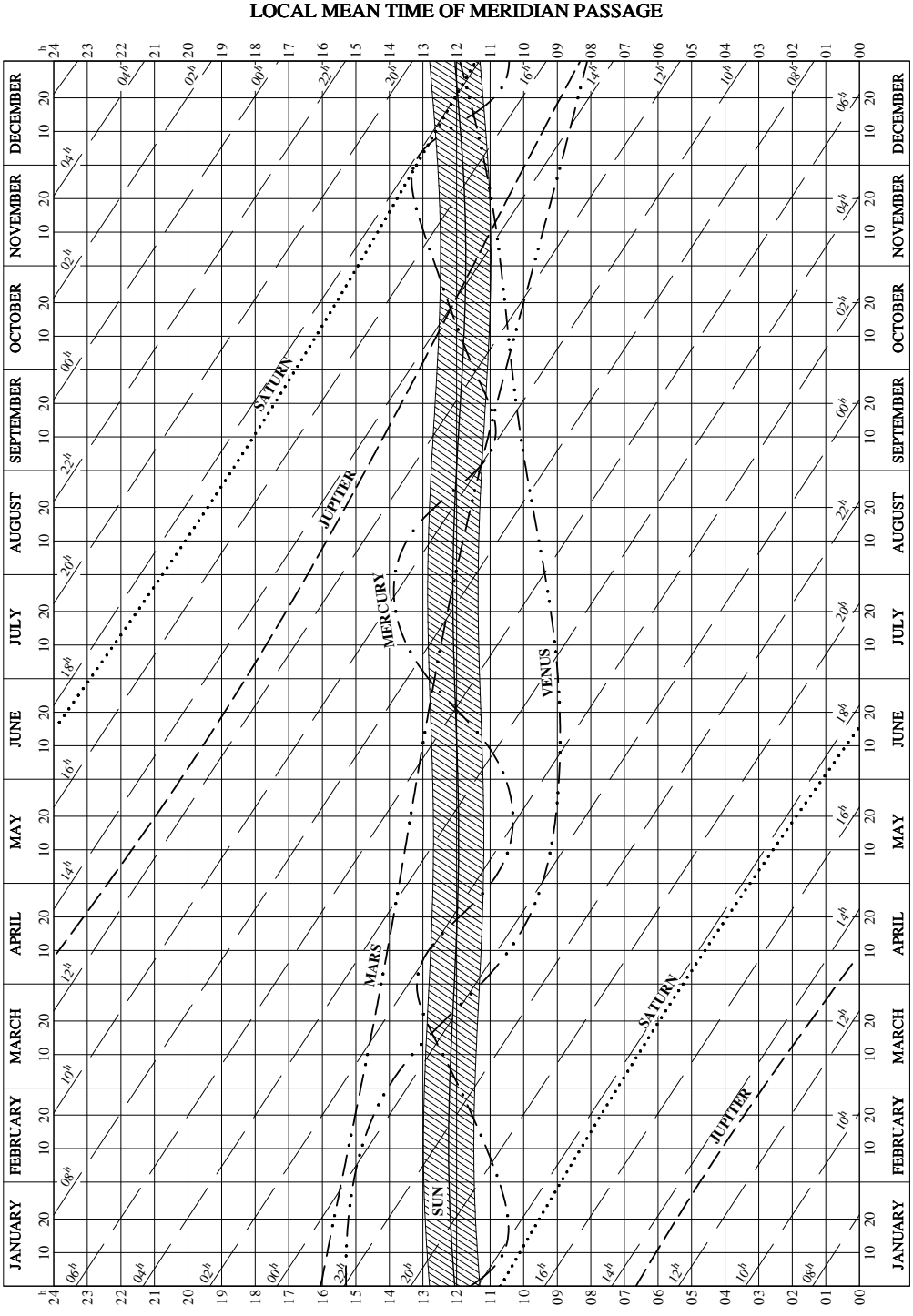
a) whether a planet or star is too close to the Sun for observation;
b) visibility of a planet or star in the morning or evening;
c) location of a planet or star during twilight;
d) proximity of planets to stars or other planets.

When the meridian passage of a body occurs at midnight, it is close to opposition to the Sun and is visible all night, and may be observed in both morning and evening twilights. As the time of meridian passage decreases, the body ceases to be observable in the morning, but its altitude above the eastern horizon during evening twilight gradually increases until it is on the meridian at evening twilight. From then onwards the body is observable above the western horizon, its altitude at evening twilight gradually decreasing, until it becomes too close to the Sun for observation. When it again becomes visible, it is seen in the morning twilight, low in the east. Its altitude at morning twilight gradually increases until meridian passage occurs at the time of morning twilight, then as the time of meridian passage decreases to 0^h, the body is observable in the west in the morning twilight with a gradually decreasing altitude, until it once again reaches opposition.

Notes on the visibility of the planets are given on page 7. Further information on the visibility of planets may be obtained from the diagram below which shows, in graphical form for any date during the year, the declinations of the bodies plotted on the planet diagram on page 9.

DECLINATION OF SUN AND PLANETS, 2017




LOCAL MEAN TIME OF MERIDIAN PASSAGE
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
SATURN
JUPITER
MERCURY
VENUS
MARS
SUN
SATURN
JUPITER
LOCAL MEAN TIME OF MERIDIAN PASSAGE

ELONGATIONS AND MAGNITUDES OF PLANETS AT 0^h UT

Date	Mercury		Venus	
	Elong.	Mag.	Elong.	Mag.
	°		°	
Jan. −3	E. 3	·	E. 46	−4·4
2	W. 10	+2·6	E. 47	−4·4
7	W. 18	+0·6	E. 47	−4·5
12	W. 22	0·0	E. 47	−4·5
17	W. 24	−0·2	E. 47	−4·6
22	W. 24	−0·2	E. 47	−4·6
27	W. 23	−0·2	E. 46	−4·7
Feb. 1	W. 21	−0·2	E. 46	−4·7
6	W. 19	−0·2	E. 44	−4·8
11	W. 17	−0·3	E. 43	−4·8
16	W. 14	−0·5	E. 41	−4·8
21	W. 11	−0·7	E. 38	−4·8
26	W. 8	−1·0	E. 35	−4·8
Mar. 3	W. 4	−1·5	E. 31	−4·8
8	E. 2	−1·9	E. 26	−4·7
13	E. 6	−1·6	E. 21	−4·5
18	E. 11	−1·4	E. 14	−4·3
23	E. 15	−1·1	E. 9	−4·2
28	E. 18	−0·7	W. 9	−4·2
Apr. 2	E. 19	−0·1	W. 14	−4·2
7	E. 17	+1·0	W. 20	−4·4
12	E. 13	+2·6	W. 26	−4·6
17	E. 6	+5·0	W. 30	−4·7
22	W. 3	·	W. 34	−4·7
27	W. 11	+3·7	W. 38	−4·7
May 2	W. 17	+2·3	W. 40	−4·7
7	W. 22	+1·4	W. 42	−4·7
12	W. 25	+0·8	W. 43	−4·7
17	W. 26	+0·5	W. 45	−4·6
22	W. 25	+0·2	W. 45	−4·6
27	W. 24	−0·1	W. 46	−4·5
June 1	W. 21	−0·4	W. 46	−4·5
6	W. 17	−0·7	W. 46	−4·4
11	W. 12	−1·1	W. 46	−4·4
16	W. 7	−1·6	W. 45	−4·3
21	W. 1	−2·4	W. 45	−4·3
26	E. 6	−1·7	W. 44	−4·2
July 1	E. 11	−1·1	W. 44	−4·2

Date	Mercury		Venus	
	Elong.	Mag.	Elong.	Mag.
	°		°	
July 1	E. 11	−1·1	W. 44	−4·2
6	E. 16	−0·7	W. 43	−4·2
11	E. 20	−0·4	W. 42	−4·1
16	E. 23	−0·2	W. 42	−4·1
21	E. 25	0·0	W. 41	−4·1
26	E. 27	+0·2	W. 40	−4·0
31	E. 27	+0·3	W. 39	−4·0
Aug. 5	E. 26	+0·6	W. 38	−4·0
10	E. 24	+1·0	W. 37	−4·0
15	E. 20	+1·7	W. 36	−4·0
20	E. 13	+2·9	W. 35	−3·9
25	E. 6	+4·9	W. 33	−3·9
30	W. 7	+4·4	W. 32	−3·9
Sept. 4	W. 13	+1·9	W. 31	−3·9
9	W. 17	+0·2	W. 30	−3·9
14	W. 18	−0·6	W. 29	−3·9
19	W. 16	−1·0	W. 28	−3·9
24	W. 12	−1·2	W. 26	−3·9
29	W. 8	−1·3	W. 25	−3·9
Oct. 4	W. 4	−1·5	W. 24	−3·9
9	E. 1	−1·7	W. 23	−3·9
14	E. 4	−1·3	W. 21	−3·9
19	E. 7	−0·9	W. 20	−3·9
24	E. 10	−0·6	W. 19	−3·9
29	E. 13	−0·5	W. 18	−3·9
Nov. 3	E. 15	−0·4	W. 16	−3·9
8	E. 18	−0·3	W. 15	−3·9
13	E. 20	−0·3	W. 14	−3·9
18	E. 21	−0·4	W. 13	−3·9
23	E. 22	−0·4	W. 11	−3·9
28	E. 21	−0·3	W. 10	−3·9
Dec. 3	E. 18	+0·2	W. 9	−3·9
8	E. 11	+2·1	W. 8	−3·9
13	E. 2	·	W. 7	−3·9
18	W. 11	+2·1	W. 5	−3·9
23	W. 19	+0·3	W. 4	−3·9
28	W. 22	−0·3	W. 3	−4·0
33	W. 23	−0·4	W. 2	−4·0

SELECTED DWARF AND MINOR PLANETS

	Conjunction	Stationary	Opposition	Stationary
Ceres	June 6	Dec. 21	—	—
Pallas	Mar. 15	Sept. 25	Oct. 29	Dec. 24
Juno	—	May 8	July 2	Aug. 26
Vesta	Sept. 27	—	Jan. 18	Mar. 7
Pluto	Jan. 7	Apr. 20	July 10	Sept. 28

ELONGATIONS AND MAGNITUDES OF PLANETS AT 0^h UT

Date	Mars		Jupiter		Saturn		Uranus		Neptune	
	Elong.	Mag.	Elong.	Mag.	Elong.	Mag.	Elong.	Mag.	Elong.	Mag.
	°		°		°		°		°	
Jan. −3	E. 60	+0·9	W. 76	−1·9	W. 16	+0·5	E. 104	+5·8	E. 63	+7·9
7	E. 57	+0·9	W. 85	−2·0	W. 25	+0·5	E. 94	+5·8	E. 53	+7·9
17	E. 55	+1·0	W. 95	−2·0	W. 34	+0·5	E. 84	+5·8	E. 43	+7·9
27	E. 52	+1·1	W. 104	−2·1	W. 43	+0·5	E. 74	+5·8	E. 33	+8·0
Feb. 6	E. 49	+1·2	W. 114	−2·2	W. 52	+0·5	E. 64	+5·9	E. 23	+8·0
16	E. 46	+1·2	W. 124	−2·3	W. 62	+0·5	E. 54	+5·9	E. 14	+8·0
26	E. 44	+1·3	W. 135	−2·3	W. 71	+0·5	E. 44	+5·9	E. 4	+8·0
Mar. 8	E. 41	+1·3	W. 146	−2·4	W. 81	+0·5	E. 35	+5·9	W. 6	+8·0
18	E. 38	+1·4	W. 157	−2·4	W. 90	+0·5	E. 25	+5·9	W. 15	+8·0
28	E. 35	+1·5	W. 168	−2·4	W. 100	+0·4	E. 16	+5·9	W. 25	+8·0
Apr. 7	E. 33	+1·5	W. 178	−2·5	W. 110	+0·4	E. 7	+5·9	W. 34	+8·0
17	E. 30	+1·5	E. 170	−2·5	W. 119	+0·3	W. 3	+5·9	W. 44	+7·9
27	E. 27	+1·6	E. 159	−2·4	W. 129	+0·3	W. 12	+5·9	W. 53	+7·9
May 7	E. 24	+1·6	E. 148	−2·4	W. 140	+0·2	W. 21	+5·9	W. 63	+7·9
17	E. 21	+1·6	E. 138	−2·3	W. 150	+0·2	W. 30	+5·9	W. 72	+7·9
27	E. 18	+1·7	E. 128	−2·3	W. 160	+0·1	W. 39	+5·9	W. 82	+7·9
June 6	E. 15	+1·7	E. 118	−2·2	W. 170	0·0	W. 48	+5·9	W. 91	+7·9
16	E. 12	+1·7	E. 108	−2·1	E. 179	0·0	W. 57	+5·9	W. 101	+7·9
26	E. 10	+1·7	E. 99	−2·1	E. 169	+0·1	W. 67	+5·8	W. 110	+7·9
July 6	E. 7	+1·7	E. 90	−2·0	E. 159	+0·1	W. 76	+5·8	W. 120	+7·9
16	E. 4	+1·7	E. 81	−2·0	E. 149	+0·2	W. 85	+5·8	W. 130	+7·8
26	E. 1	+1·7	E. 73	−1·9	E. 139	+0·2	W. 95	+5·8	W. 139	+7·8
Aug. 5	W. 3	+1·7	E. 65	−1·9	E. 129	+0·3	W. 104	+5·8	W. 149	+7·8
15	W. 6	+1·8	E. 57	−1·8	E. 119	+0·3	W. 114	+5·8	W. 159	+7·8
25	W. 9	+1·8	E. 49	−1·8	E. 109	+0·4	W. 124	+5·7	W. 169	+7·8
Sept. 4	W. 13	+1·8	E. 41	−1·7	E. 100	+0·4	W. 134	+5·7	W. 178	+7·8
14	W. 16	+1·8	E. 33	−1·7	E. 90	+0·5	W. 144	+5·7	E. 171	+7·8
24	W. 19	+1·8	E. 25	−1·7	E. 81	+0·5	W. 154	+5·7	E. 161	+7·8
Oct. 4	W. 23	+1·8	E. 18	−1·7	E. 71	+0·5	W. 164	+5·7	E. 151	+7·8
14	W. 26	+1·8	E. 10	−1·7	E. 62	+0·5	W. 174	+5·7	E. 141	+7·8
24	W. 30	+1·8	E. 2	−1·7	E. 53	+0·5	E. 176	+5·7	E. 131	+7·8
Nov. 3	W. 34	+1·8	W. 6	−1·7	E. 44	+0·5	E. 165	+5·7	E. 121	+7·9
13	W. 37	+1·8	W. 14	−1·7	E. 35	+0·5	E. 155	+5·7	E. 111	+7·9
23	W. 41	+1·7	W. 22	−1·7	E. 26	+0·5	E. 144	+5·7	E. 101	+7·9
Dec. 3	W. 45	+1·7	W. 30	−1·7	E. 17	+0·5	E. 134	+5·7	E. 90	+7·9
13	W. 49	+1·6	W. 38	−1·7	E. 8	+0·5	E. 124	+5·7	E. 80	+7·9
23	W. 53	+1·5	W. 46	−1·8	W. 1	+0·4	E. 113	+5·8	E. 70	+7·9
33	W. 57	+1·5	W. 54	−1·8	W. 10	+0·5	E. 103	+5·8	E. 60	+7·9

VISUAL MAGNITUDES OF SELECTED DWARF & MINOR PLANETS

	Jan. 7	Feb. 16	Mar. 28	May 7	June 16	July 26	Sept. 4	Oct. 14	Nov. 23	Dec. 33
Ceres	8·7	9·0	9·0	8·8	8·6	8·9	8·9	8·7	8·2	7·4
Pallas	10·3	10·1	9·9	10·1	10·0	9·6	8·9	8·3	8·3	8·7
Juno	11·5	11·4	11·1	10·6	9·9	9·9	10·4	10·7	10·8	10·7
Vesta	6·5	6·8	7·5	8·0	8·2	8·1	7·9	7·8	7·9	7·9
Pluto	14·3	14·3	14·2	14·2	14·2	14·2	14·2	14·2	14·3	14·3

CONFIGURATIONS OF SUN, MOON AND PLANETS

	d	h		
Jan.	1	07	Mars 0°.02 S. of Neptune	
	2	09	Venus 1°.9 S. of Moon	
	3	04	Neptune 0°.4 S. of Moon	Occn.
	3	07	Mars 0°.2 S. of Moon	Occn.
	4	14	Earth at perihelion	
	5	20	FIRST QUARTER	
	6	02	Uranus 3° N. of Moon	
	7	07	Pluto in conjunction with Sun	
	8	10	Mercury stationary	
	9	15	*Aldebaran* 0°.4 S. of Moon	Occn.
	10	06	Moon at perigee	
	12	12	FULL MOON	
	12	13	Venus greatest elong. E. (47°)	
	13	02	Venus 0°.4 N. of Neptune	
	15	05	*Regulus* 0°.8 N. of Moon	Occn.
	18	01	Vesta at opposition	
	19	05	Jupiter 3° S. of Moon	
	19	10	Mercury greatest elong. W. (24°)	
	19	22	LAST QUARTER	
	20	21	Jupiter 4° N. of *Spica*	
	22	00	Moon at apogee	
	24	10	Saturn 4° S. of Moon	
	26	01	Mercury 4° S. of Moon	
	28	00	NEW MOON	
	30	11	Neptune 0°.2 S. of Moon	Occn.
	31	15	Venus 4° N. of Moon	
Feb.	1	01	Mars 2° N. of Moon	
	2	08	Uranus 3° N. of Moon	
	3	02	Ceres 1°.0 S. of Moon	Occn.
	4	04	FIRST QUARTER	
	5	22	*Aldebaran* 0°.2 S. of Moon	Occn.
	6	14	Moon at perigee	
	6	19	Jupiter stationary	
	11	01	FULL MOON	Penumbral Eclipse
	11	14	*Regulus* 0°.8 N. of Moon	Occn.
	15	15	Jupiter 3° S. of Moon	
	17	07	Venus greatest illuminated extent	
	18	20	LAST QUARTER	
	18	21	Moon at apogee	
	20	23	Saturn 4° S. of Moon	
	23	16	Jupiter 4° N. of *Spica*	
	26	15	NEW MOON	Eclipse
	27	08	Mars 0°.6 N. of Uranus	
	28	20	Venus 10° N. of Moon	
Mar.	1	16	Uranus 4° N. of Moon	
	1	19	Mars 4° N. of Moon	
	2	03	Neptune in conjunction with Sun	
	2	14	Venus stationary	
	2	21	Ceres 0°.8 N. of Moon	Occn.
	3	08	Moon at perigee	
	5	03	*Aldebaran* 0°.2 S. of Moon	Occn.
	5	12	FIRST QUARTER	
	7	00	Mercury in superior conjunction	
	7	03	Vesta stationary	
	10	23	*Regulus* 0°.8 N. of Moon	Occn.
	12	15	FULL MOON	
	14	20	Jupiter 2° S. of Moon	
	15	03	Pallas in conjunction with Sun	
	18	17	Moon at apogee	
	20	10	Equinox	
	20	10	Saturn 3° S. of Moon	
	20	16	LAST QUARTER	
	25	10	Venus in inferior conjunction	
	26	08	Neptune 0°.005 N. of Moon	Occn.
	28	03	NEW MOON	
	29	07	Mercury 7° N. of Moon	
	30	13	Mars 5° N. of Moon	
	30	13	Moon at perigee	
Apr.	1	09	*Aldebaran* 0°.3 S. of Moon	Occn.
	1	10	Mercury greatest elong. E. (19°)	
	3	19	FIRST QUARTER	
	6	05	Saturn stationary	
	7	05	*Regulus* 0°.7 N. of Moon	Occn.
	7	22	Jupiter at opposition	
	10	01	Mercury stationary	
	10	21	Jupiter 2° S. of Moon	
	11	06	FULL MOON	
	13	00	Venus stationary	
	14	06	Uranus in conjunction with Sun	
	15	10	Moon at apogee	
	16	18	Saturn 3° S. of Moon	
	19	10	LAST QUARTER	
	20	06	Mercury in inferior conjunction	
	20	21	Pluto stationary	
	22	20	Neptune 0°.2 N. of Moon	Occn.
	23	18	Venus 5° N. of Moon	
	24	16	Pallas 0°.8 S. of Moon	Occn.
	26	12	NEW MOON	
	27	16	Moon at perigee	
	28	08	Mars 6° N. of Moon	
	28	18	*Aldebaran* 0°.5 S. of Moon	Occn.
	30	04	Venus greatest illuminated extent	
May	2	14	Mercury stationary	
	3	03	FIRST QUARTER	
	4	10	*Regulus* 0°.5 N. of Moon	Occn.
	7	07	Mars 6° N. of *Aldebaran*	
	7	21	Jupiter 2° S. of Moon	
	7	23	Mercury 2° S. of Uranus	
	8	08	Juno stationary	
	10	22	FULL MOON	

CONFIGURATIONS OF SUN, MOON AND PLANETS

	d	h		
May	12	20	Moon at apogee	
	13	23	Saturn 3° S. of Moon	
	17	23	Mercury greatest elong. W. (26°)	
	19	01	LAST QUARTER	
	20	06	Neptune 0°.5 N. of Moon	Occn.
	22	13	Venus 2° N. of Moon	
	23	05	Uranus 4° N. of Moon	
	24	01	Mercury 1°.6 N. of Moon	
	25	20	NEW MOON	
	26	01	Moon at perigee	
	27	02	Mars 5° N. of Moon	
	31	17	*Regulus* 0°.3 N. of Moon	Occn.
June	1	13	FIRST QUARTER	
	2	15	Venus 1°.8 S. of Uranus	
	3	13	Venus greatest elong. W. (46°)	
	4	00	Jupiter 2° S. of Moon	
	6	00	Ceres in conjunction with Sun	
	8	22	Moon at apogee	
	9	13	FULL MOON	
	10	01	Saturn 3° S. of Moon	
	10	05	Jupiter stationary	
	12	11	Mercury 5° N. of *Aldebaran*	
	15	10	Saturn at opposition	
	16	13	Neptune 0°.7 N. of Moon	Occn.
	16	23	Neptune stationary	
	17	12	LAST QUARTER	
	19	16	Uranus 4° N. of Moon	
	20	21	Venus 2° N. of Moon	
	21	04	Solstice	
	21	14	Mercury in superior conjunction	
	22	15	*Aldebaran* 0°.5 S. of Moon	Occn.
	23	11	Moon at perigee	
	24	03	NEW MOON	
	28	01	*Regulus* 0°.03 N. of Moon	Occn.
July	1	01	FIRST QUARTER	
	1	07	Jupiter 3° S. of Moon	
	2	13	Juno at opposition	
	3	00	Mercury 5° S. of *Pollux*	
	3	20	Earth at aphelion	
	6	04	Moon at apogee	
	7	03	Saturn 3° S. of Moon	
	9	04	FULL MOON	
	10	05	Pluto at opposition	
	13	18	Neptune 0°.9 N. of Moon	Occn.
	14	11	Venus 3° N. of *Aldebaran*	
	16	19	LAST QUARTER	
	17	00	Uranus 4° N. of Moon	
	20	00	*Aldebaran* 0°.4 S. of Moon	Occn.
	20	11	Venus 3° N. of Moon	
	21	17	Moon at perigee	

	d	h		
July	23	10	NEW MOON	
	25	09	Mercury 0°.9 S. of Moon	Occn.
	25	11	*Regulus* 0°.07 S. of Moon	Occn.
	26	09	Mercury 1°.1 S. of *Regulus*	
	27	01	Mars in conjunction with Sun	
	28	20	Jupiter 3° S. of Moon	
	30	05	Mercury greatest elong. E. (27°)	
	30	15	FIRST QUARTER	
Aug.	2	18	Moon at apogee	
	3	07	Saturn 3° S. of Moon	
	3	10	Uranus stationary	
	7	18	FULL MOON	Eclipse
	9	23	Neptune 0°.9 N. of Moon	Occn.
	12	06	Mercury stationary	
	13	05	Uranus 4° N. of Moon	
	15	01	LAST QUARTER	
	16	07	*Aldebaran* 0°.4 S. of Moon	Occn.
	18	13	Moon at perigee	
	19	05	Venus 2° N. of Moon	
	21	19	NEW MOON	Eclipse
	21	19	Venus 7° S. of *Pollux*	
	25	13	Jupiter 3° S. of Moon	
	25	15	Saturn stationary	
	26	10	Juno stationary	
	26	21	Mercury in inferior conjunction	
	29	08	FIRST QUARTER	
	30	11	Moon at apogee	
	30	14	Saturn 4° S. of Moon	
Sept.	4	16	Mercury stationary	
	5	05	Neptune at opposition	
	5	11	Jupiter 3° N. of *Spica*	
	6	05	Neptune 0°.8 N. of Moon	Occn.
	6	07	FULL MOON	
	9	10	Uranus 4° N. of Moon	
	10	12	Mercury 0°.6 S. of *Regulus*	
	12	10	Mercury greatest elong. W. (18°)	
	12	13	*Aldebaran* 0°.4 S. of Moon	Occn.
	13	06	LAST QUARTER	
	13	16	Moon at perigee	
	16	18	Mercury 0°.06 N. of Mars	
	18	01	Venus 0°.5 N. of Moon	Occn.
	18	05	*Regulus* 0°.09 S. of Moon	Occn.
	18	20	Mars 0°.1 S. of Moon	Occn.
	18	23	Mercury 0°.03 N. of Moon	Occn.
	19	23	Venus 0°.5 N. of *Regulus*	
	20	05	NEW MOON	
	22	08	Jupiter 4° S. of Moon	
	22	20	Equinox	
	25	11	Pallas stationary	
	27	00	Saturn 3° S. of Moon	

CONFIGURATIONS OF SUN, MOON AND PLANETS

	d	h		
Sept.	27	07	Moon at apogee	
	27	14	Vesta in conjunction with Sun	
	28	03	FIRST QUARTER	
	28	08	Pluto stationary	
Oct.	3	12	Neptune 0°.7 N. of Moon	Occn.
	5	13	Venus 0°.2 N. of Mars	
	5	19	FULL MOON	
	6	16	Uranus 4° N. of Moon	
	8	21	Mercury in superior conjunction	
	9	06	Moon at perigee	
	9	19	*Aldebaran* 0°.6 S. of Moon	Occn.
	12	12	LAST QUARTER	
	15	11	*Regulus* 0°.2 S. of Moon	Occn.
	17	10	Mars 1°.8 S. of Moon	
	18	00	Venus 2° S. of Moon	
	19	18	Uranus at opposition	
	19	19	NEW MOON	
	24	12	Saturn 3° S. of Moon	
	25	02	Moon at apogee	
	26	18	Jupiter in conjunction with Sun	
	27	22	FIRST QUARTER	
	29	00	Pallas at opposition	
	30	21	Neptune 0°.9 N. of Moon	Occn.
Nov.	1	15	Venus 4° N. of *Spica*	
	3	01	Uranus 4° N. of Moon	
	4	05	FULL MOON	
	6	00	Moon at perigee	
	6	03	*Aldebaran* 0°.8 S. of Moon	Occn.
	10	21	LAST QUARTER	
	11	17	*Regulus* 0°.4 S. of Moon	Occn.
	12	15	Mercury 2° N. of *Antares*	
	13	06	Venus 0°.3 N. of Jupiter	
	15	01	Mars 3° S. of Moon	
	16	09	Vesta 0°.4 N. of Moon	Occn.
	16	21	Jupiter 4° S. of Moon	
	18	12	NEW MOON	
	20	09	Mercury 7° S. of Moon	
	21	00	Saturn 3° S. of Moon	
	21	19	Moon at apogee	
	22	21	Neptune stationary	
	24	00	Mercury greatest elong. E. (22°)	
	26	17	FIRST QUARTER	
	27	05	Neptune 1°.2 N. of Moon	Occn.
	28	00	Mars 3° N. of *Spica*	
	28	09	Mercury 3° S. of Saturn	
	30	10	Uranus 4° N. of Moon	
Dec.	3	08	Mercury stationary	
	3	13	*Aldebaran* 0°.8 S. of Moon	Occn.
	3	16	FULL MOON	
	4	09	Moon at perigee	
	8	23	*Regulus* 0°.7 S. of Moon	Occn.
	10	08	LAST QUARTER	
	13	02	Mercury in inferior conjunction	
	13	16	Mars 4° S. of Moon	
	14	14	Jupiter 4° S. of Moon	
	14	19	Vesta 0°.2 N. of Moon	Occn.
	18	07	NEW MOON	
	19	01	Moon at apogee	
	21	16	Solstice	
	21	21	Ceres stationary	
	21	21	Saturn in conjunction with Sun	
	23	03	Mercury stationary	
	24	06	Pallas stationary	
	24	13	Neptune 1°.4 N. of Moon	
	26	09	FIRST QUARTER	
	27	18	Uranus 5° N. of Moon	
	31	01	*Aldebaran* 0°.8 S. of Moon	Occn.

. . . *continued from page 5*

OCCULTATIONS OF PLANETS AND BRIGHT STARS BY THE MOON

Date			Body	Areas of Visibility
	d	h		
Oct.	9	19	*Aldebaran*	Central and N.E Asia, Alaska, N.W. Canada
Oct.	15	11	*Regulus*	N. America except Canada, most of Caribbean, Cape Verde, W. Africa
Oct.	30	21	Neptune	Most of Antarctica, S. tip of Africa
Nov.	6	03	*Aldebaran*	North America except westernmost part, N. Europe, N.W. Asia
Nov.	11	17	*Regulus*	Japan, E. Asia, S.W. North America, Central America
Nov.	16	09	Vesta	E. Brazil, S.W. Africa, Kerguelen Is.
Nov.	27	05	Neptune	West and Central Antarctica
Dec.	3	13	*Aldebaran*	Central and N. Asia, N. Greenland, N.W. North America
Dec.	8	23	*Regulus*	N.E. and Central Europe, N. Greenland, N. Asia, N. parts of Micronesia
Dec.	14	19	Vesta	Central Polynesia, parts of Chile and Argentina
Dec.	31	01	*Aldebaran*	Most of North America, Greenland, Europe except S., W. Russia

CHRONOLOGICAL CYCLES AND ERAS

Dominical Letter	A	Julian Period (year of)	6730
Epact	2	Roman Indiction	10
Golden Number (Lunar Cycle)	IV	Solar Cycle	10

All dates are given in terms of the Gregorian calendar in which 2017 January 14 corresponds to 2017 January 1 of the Julian calendar.

ERA	YEAR	BEGINS	ERA	YEAR	BEGINS
Byzantine	7526	Sept. 14	Japanese	2677	Jan. 1
Jewish (A.M.)*	5778	Sept. 20	Seleucidæ (Grecian)	2329	Sept. 14 (or Oct. 14)
Chinese (dīng yǒu)		Jan. 28			
Roman (A.U.C.)	2770	Jan. 14	Saka (Indian)	1939	Mar. 22
Nabonassar	2766	Apr. 19	Diocletian (Coptic)	1734	Sept. 11
			Islamic (Hegira)*	1439	Sept. 21

* Year begins at sunset

RELIGIOUS CALENDARS

Epiphany	Jan. 6	Ascension Day	May 25
Ash Wednesday	Mar. 1	Whit Sunday—Pentecost	June 4
Palm Sunday	Apr. 9	Trinity Sunday	June 11
Good Friday	Apr. 14	First Sunday in Advent	Dec. 3
Easter Day	Apr. 16	Christmas Day (Monday)	Dec. 25
First Day of Passover (Pesach)	Apr. 11	Day of Atonement (Yom Kippur)	Sept. 30
Feast of Weeks (Shavuot)	May 31	First day of Tabernacles (Succoth)	Oct. 5
Jewish New Year‡ (Rosh Hashanah)	Sept. 21	Festival of Lights (Hanukkah)	Dec. 13
First day of Ramadân‡	May 27	Islamic New Year‡	Sept. 22
First day of Shawwal‡	June 26		

‡The Jewish and Islamic dates above are tabular dates, which begin at sunset on the previous evening and end at sunset on the date tabulated. In practice, the dates of Islamic fasts and festivals are determined by an actual sighting of the appropriate new Moon.

CIVIL CALENDAR—UNITED STATES OF AMERICA

New Year's Day	Jan. 1	Labor Day	Sept. 4
Martin Luther King's Birthday	Jan. 16	Columbus Day	Oct. 9
Washington's Birthday	Feb. 20	Election Day (in certain States)	Nov. 7
Memorial Day	May 29	Veterans Day	Nov. 11
Independence Day	July 4	Thanksgiving Day	Nov. 23

CIVIL CALENDAR—UNITED KINGDOM

Accession of Queen Elizabeth II	Feb. 6	The Queen's Official Birthday†	June 10
St David (Wales)	Mar. 1	Birthday of Prince Philip, Duke of Edinburgh	June 10
Commonwealth Day	Mar. 13	Remembrance Sunday	Nov. 12
St Patrick (Ireland)	Mar. 17	Birthday of the Prince of Wales	Nov. 14
Birthday of Queen Elizabeth II	Apr. 21	St Andrew (Scotland)	Nov. 30
St George (England)	Apr. 23		
Coronation Day	June 2		

†Date subject to confirmation

	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE	
Day of Month	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year
1	Sun.	1	Wed.	32	Wed.	60	Sat.	91	Mon.	121	Thu.	152
2	Mon.	2	Thu.	33	Thu.	61	Sun.	92	Tue.	122	Fri.	153
3	Tue.	3	Fri.	34	Fri.	62	Mon.	93	Wed.	123	Sat.	154
4	Wed.	4	Sat.	35	Sat.	63	Tue.	94	Thu.	124	Sun.	155
5	Thu.	5	Sun.	36	Sun.	64	Wed.	95	Fri.	125	Mon.	156
6	Fri.	6	Mon.	37	Mon.	65	Thu.	96	Sat.	126	Tue.	157
7	Sat.	7	Tue.	38	Tue.	66	Fri.	97	Sun.	127	Wed.	158
8	Sun.	8	Wed.	39	Wed.	67	Sat.	98	Mon.	128	Thu.	159
9	Mon.	9	Thu.	40	Thu.	68	Sun.	99	Tue.	129	Fri.	160
10	Tue.	10	Fri.	41	Fri.	69	Mon.	100	Wed.	130	Sat.	161
11	Wed.	11	Sat.	42	Sat.	70	Tue.	101	Thu.	131	Sun.	162
12	Thu.	12	Sun.	43	Sun.	71	Wed.	102	Fri.	132	Mon.	163
13	Fri.	13	Mon.	44	Mon.	72	Thu.	103	Sat.	133	Tue.	164
14	Sat.	14	Tue.	45	Tue.	73	Fri.	104	Sun.	134	Wed.	165
15	Sun.	15	Wed.	46	Wed.	74	Sat.	105	Mon.	135	Thu.	166
16	Mon.	16	Thu.	47	Thu.	75	Sun.	106	Tue.	136	Fri.	167
17	Tue.	17	Fri.	48	Fri.	76	Mon.	107	Wed.	137	Sat.	168
18	Wed.	18	Sat.	49	Sat.	77	Tue.	108	Thu.	138	Sun.	169
19	Thu.	19	Sun.	50	Sun.	78	Wed.	109	Fri.	139	Mon.	170
20	Fri.	20	Mon.	51	Mon.	79	Thu.	110	Sat.	140	Tue.	171
21	Sat.	21	Tue.	52	Tue.	80	Fri.	111	Sun.	141	Wed.	172
22	Sun.	22	Wed.	53	Wed.	81	Sat.	112	Mon.	142	Thu.	173
23	Mon.	23	Thu.	54	Thu.	82	Sun.	113	Tue.	143	Fri.	174
24	Tue.	24	Fri.	55	Fri.	83	Mon.	114	Wed.	144	Sat.	175
25	Wed.	25	Sat.	56	Sat.	84	Tue.	115	Thu.	145	Sun.	176
26	Thu.	26	Sun.	57	Sun.	85	Wed.	116	Fri.	146	Mon.	177
27	Fri.	27	Mon.	58	Mon.	86	Thu.	117	Sat.	147	Tue.	178
28	Sat.	28	Tue.	59	Tue.	87	Fri.	118	Sun.	148	Wed.	179
29	Sun.	29			Wed.	88	Sat.	119	Mon.	149	Thu.	180
30	Mon.	30			Thu.	89	Sun.	120	Tue.	150	Fri.	181
31	Tue.	31			Fri.	90			Wed.	151		

JULIAN DATE, 2017

0^h UT	JD	0^h UT	JD	0^h UT	JD
Jan. 0	245 7753·5	May 0	245 7873·5	Sept. 0	245 7996·5
Feb. 0	245 7784·5	June 0	245 7904·5	Oct. 0	245 8026·5
Mar. 0	245 7812·5	July 0	245 7934·5	Nov. 0	245 8057·5
Apr. 0	245 7843·5	Aug. 0	245 7965·5	Dec. 0	245 8087·5

400-day date, JD 245 8000·5 = 2017 September 4·0

Standard epoch, 1900 January 0, 12^h UT = JD 241 5020·0
Standard epoch, B1950·0 = 1950 Jan. 0·923 = JD 243 3282·423
B2017·0 = 2017 Jan. 0·151 = JD 245 7753·651

Standard epoch, J2000·0 = 2000 Jan. 1·5 = JD 245 1545·0
J2017·5 = 2017 July 2·375 = JD 245 7936·875

	JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
Day of Month	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year
1	Sat.	182	Tue.	213	Fri.	244	Sun.	274	Wed.	305	Fri.	335
2	Sun.	183	Wed.	214	Sat.	245	Mon.	275	Thu.	306	Sat.	336
3	Mon.	184	Thu.	215	Sun.	246	Tue.	276	Fri.	307	Sun.	337
4	Tue.	185	Fri.	216	Mon.	247	Wed.	277	Sat.	308	Mon.	338
5	Wed.	186	Sat.	217	Tue.	248	Thu.	278	Sun.	309	Tue.	339
6	Thu.	187	Sun.	218	Wed.	249	Fri.	279	Mon.	310	Wed.	340
7	Fri.	188	Mon.	219	Thu.	250	Sat.	280	Tue.	311	Thu.	341
8	Sat.	189	Tue.	220	Fri.	251	Sun.	281	Wed.	312	Fri.	342
9	Sun.	190	Wed.	221	Sat.	252	Mon.	282	Thu.	313	Sat.	343
10	Mon.	191	Thu.	222	Sun.	253	Tue.	283	Fri.	314	Sun.	344
11	Tue.	192	Fri.	223	Mon.	254	Wed.	284	Sat.	315	Mon.	345
12	Wed.	193	Sat.	224	Tue.	255	Thu.	285	Sun.	316	Tue.	346
13	Thu.	194	Sun.	225	Wed.	256	Fri.	286	Mon.	317	Wed.	347
14	Fri.	195	Mon.	226	Thu.	257	Sat.	287	Tue.	318	Thu.	348
15	Sat.	196	Tue.	227	Fri.	258	Sun.	288	Wed.	319	Fri.	349
16	Sun.	197	Wed.	228	Sat.	259	Mon.	289	Thu.	320	Sat.	350
17	Mon.	198	Thu.	229	Sun.	260	Tue.	290	Fri.	321	Sun.	351
18	Tue.	199	Fri.	230	Mon.	261	Wed.	291	Sat.	322	Mon.	352
19	Wed.	200	Sat.	231	Tue.	262	Thu.	292	Sun.	323	Tue.	353
20	Thu.	201	Sun.	232	Wed.	263	Fri.	293	Mon.	324	Wed.	354
21	Fri.	202	Mon.	233	Thu.	264	Sat.	294	Tue.	325	Thu.	355
22	Sat.	203	Tue.	234	Fri.	265	Sun.	295	Wed.	326	Fri.	356
23	Sun.	204	Wed.	235	Sat.	266	Mon.	296	Thu.	327	Sat.	357
24	Mon.	205	Thu.	236	Sun.	267	Tue.	297	Fri.	328	Sun.	358
25	Tue.	206	Fri.	237	Mon.	268	Wed.	298	Sat.	329	Mon.	359
26	Wed.	207	Sat.	238	Tue.	269	Thu.	299	Sun.	330	Tue.	360
27	Thu.	208	Sun.	239	Wed.	270	Fri.	300	Mon.	331	Wed.	361
28	Fri.	209	Mon.	240	Thu.	271	Sat.	301	Tue.	332	Thu.	362
29	Sat.	210	Tue.	241	Fri.	272	Sun.	302	Wed.	333	Fri.	363
30	Sun.	211	Wed.	242	Sat.	273	Mon.	303	Thu.	334	Sat.	364
31	Mon.	212	Thu.	243			Tue.	304			Sun.	365

MEAN SIDEREAL TIME, 2017

Greenwich mean sidereal time at 0^h UT

	h		h		h		h
Jan. 0	6·6568	Apr. 0	12·5707	July 0	18·5503	Oct. 0	0·5956
Feb. 0	8·6938	May 0	14·5420	Aug. 0	20·5873	Nov. 0	2·6326
Mar. 0	10·5337	June 0	16·5790	Sept. 0	22·6243	Dec. 0	4·6039

Greenwich mean sidereal time (GMST) on day d of month at hour t UT

$$= \text{GMST at } 0^h \text{ UT on day } 0 + 0^h.065\,71\,d + 1^h.002\,74\,t$$

$$\text{Local mean sidereal time} = \text{GMST} \begin{matrix} + \text{ east} \\ - \text{ west} \end{matrix} \text{ longitude}$$

AT 0^h UNIVERSAL TIME

Date	Equation of time	Declination	Date	Equation of time	Declination	Date	Equation of time	Declination	Date	Equation of time	Declination
	m s	° ′		m s	° ′		m s	° ′		m s	° ′
Jan. 0	−02 58	−23 05	**Feb. 15**	−14 07	−12 41	**Apr. 1**	−03 57	+04 32	**May 17**	+03 38	+19 19
1	03 26	23 00	**16**	14 03	12 20	**2**	03 39	04 55	**18**	03 36	19 32
2	03 55	22 55	**17**	13 59	11 59	**3**	03 22	05 18	**19**	03 33	19 46
3	04 23	22 49	**18**	13 55	11 38	**4**	03 04	05 41	**20**	03 30	19 58
4	04 50	22 43	**19**	13 50	11 17	**5**	02 47	06 04	**21**	03 27	20 11
5	−05 17	−22 37	**20**	−13 44	−10 56	**6**	−02 30	+06 26	**22**	+03 22	+20 23
6	05 44	22 30	**21**	13 37	10 34	**7**	02 13	06 49	**23**	03 18	20 34
7	06 10	22 22	**22**	13 30	10 12	**8**	01 56	07 12	**24**	03 12	20 46
8	06 35	22 14	**23**	13 22	09 50	**9**	01 39	07 34	**25**	03 06	20 56
9	07 00	22 06	**24**	13 13	09 28	**10**	01 23	07 56	**26**	03 00	21 07
10	−07 25	−21 57	**25**	−13 04	−09 06	**11**	−01 07	+08 18	**27**	+02 53	+21 17
11	07 49	21 48	**26**	12 55	08 44	**12**	00 51	08 40	**28**	02 46	21 27
12	08 12	21 39	**27**	12 45	08 21	**13**	00 36	09 02	**29**	02 38	21 37
13	08 35	21 29	**28**	12 34	07 58	**14**	00 20	09 24	**30**	02 30	21 46
14	08 57	21 18	**Mar. 1**	12 23	07 36	**15**	−00 06	09 45	**31**	02 22	21 54
15	−09 19	−21 07	**2**	−12 11	−07 13	**16**	+00 09	+10 07	**June 1**	+02 13	+22 03
16	09 39	20 56	**3**	11 59	06 50	**17**	00 23	10 28	**2**	02 03	22 11
17	09 59	20 45	**4**	11 46	06 27	**18**	00 36	10 49	**3**	01 54	22 18
18	10 19	20 33	**5**	11 33	06 04	**19**	00 50	11 10	**4**	01 44	22 26
19	10 38	20 20	**6**	11 19	05 41	**20**	01 03	11 30	**5**	01 33	22 32
20	−10 56	−20 07	**7**	−11 05	−05 17	**21**	+01 15	+11 51	**6**	+01 23	+22 39
21	11 13	19 54	**8**	10 50	04 54	**22**	01 27	12 11	**7**	01 12	22 45
22	11 29	19 41	**9**	10 36	04 30	**23**	01 38	12 31	**8**	01 00	22 50
23	11 45	19 27	**10**	10 20	04 07	**24**	01 49	12 51	**9**	00 49	22 56
24	12 00	19 13	**11**	10 05	03 43	**25**	02 00	13 11	**10**	00 37	23 00
25	−12 15	−18 58	**12**	−09 49	−03 20	**26**	+02 10	+13 30	**11**	+00 25	+23 05
26	12 28	18 43	**13**	09 33	02 56	**27**	02 19	13 49	**12**	00 13	23 09
27	12 41	18 28	**14**	09 16	02 33	**28**	02 28	14 08	**13**	+00 01	23 12
28	12 53	18 12	**15**	08 59	02 09	**29**	02 37	14 27	**14**	−00 12	23 15
29	13 04	17 56	**16**	08 42	01 45	**30**	02 45	14 46	**15**	00 25	23 18
30	−13 14	−17 40	**17**	−08 25	−01 22	**May 1**	+02 52	+15 04	**16**	−00 37	+23 21
31	13 23	17 23	**18**	08 08	00 58	**2**	02 59	15 22	**17**	00 50	23 22
Feb. 1	13 32	17 06	**19**	07 50	00 34	**3**	03 06	15 40	**18**	01 03	23 24
2	13 40	16 49	**20**	07 33	−00 10	**4**	03 12	15 57	**19**	01 16	23 25
3	13 47	16 32	**21**	07 15	+00 13	**5**	03 17	16 15	**20**	01 30	23 26
4	−13 53	−16 14	**22**	−06 57	+00 37	**6**	+03 22	+16 32	**21**	−01 43	+23 26
5	13 58	15 56	**23**	06 39	01 01	**7**	03 26	16 48	**22**	01 56	23 26
6	14 02	15 37	**24**	06 21	01 24	**8**	03 30	17 05	**23**	02 09	23 25
7	14 06	15 19	**25**	06 03	01 48	**9**	03 33	17 21	**24**	02 22	23 24
8	14 09	15 00	**26**	05 45	02 12	**10**	03 36	17 37	**25**	02 35	23 23
9	−14 11	−14 41	**27**	−05 27	+02 35	**11**	+03 38	+17 52	**26**	−02 48	+23 21
10	14 12	14 21	**28**	05 09	02 59	**12**	03 39	18 08	**27**	03 00	23 19
11	14 12	14 02	**29**	04 51	03 22	**13**	03 40	18 22	**28**	03 13	23 16
12	14 12	13 42	**30**	04 33	03 45	**14**	03 40	18 37	**29**	03 25	23 13
13	14 11	13 22	**31**	04 15	04 09	**15**	03 40	18 51	**30**	03 37	23 10
14	−14 09	−13 02	**Apr. 1**	−03 57	+04 32	**16**	+03 39	+19 05	**July 1**	−03 49	+23 06
15	−14 07	−12 41	**2**	−03 39	+04 55	**17**	+03 38	+19 19	**2**	−04 00	+23 02

Equation of time = apparent time − mean time

AT 0^h UNIVERSAL TIME

Date	Equation of time	Declination	Date	Equation of time	Declination	Date	Equation of time	Declination	Date	Equation of time	Declination
	m s	° ′		m s	° ′		m s	° ′		m s	° ′
July 1	−03 49	+23 06	**Aug. 16**	−04 20	+13 44	**Oct. 1**	+10 14	−03 11	**Nov.16**	+15 17	−18 43
2	04 00	23 02	**17**	04 07	13 25	**2**	10 34	03 34	**17**	15 05	18 58
3	04 11	22 57	**18**	03 54	13 06	**3**	10 53	03 57	**18**	14 53	19 13
4	04 22	22 52	**19**	03 41	12 47	**4**	11 12	04 20	**19**	14 40	19 27
5	04 33	22 47	**20**	03 27	12 27	**5**	11 30	04 43	**20**	14 27	19 41
6	−04 43	+22 41	**21**	−03 12	+12 07	**6**	+11 48	−05 06	**21**	+14 12	−19 54
7	04 53	22 35	**22**	02 57	11 47	**7**	12 05	05 29	**22**	13 56	20 07
8	05 02	22 28	**23**	02 42	11 27	**8**	12 23	05 52	**23**	13 40	20 20
9	05 11	22 21	**24**	02 26	11 06	**9**	12 39	06 15	**24**	13 23	20 32
10	05 20	22 14	**25**	02 10	10 46	**10**	12 56	06 38	**25**	13 06	20 44
11	−05 28	+22 06	**26**	−01 53	+10 25	**11**	+13 12	−07 00	**26**	+12 47	−20 56
12	05 36	21 58	**27**	01 36	10 04	**12**	13 27	07 23	**27**	12 28	21 07
13	05 43	21 49	**28**	01 19	09 43	**13**	13 42	07 46	**28**	12 08	21 18
14	05 50	21 41	**29**	01 01	09 22	**14**	13 56	08 08	**29**	11 48	21 28
15	05 56	21 31	**30**	00 43	09 00	**15**	14 10	08 30	**30**	11 26	21 38
16	−06 02	+21 22	**31**	−00 24	+08 39	**16**	+14 23	−08 52	**Dec. 1**	+11 04	−21 48
17	06 08	21 12	**Sept. 1**	−00 06	08 17	**17**	14 35	09 14	**2**	10 42	21 57
18	06 12	21 01	**2**	+00 14	07 55	**18**	14 47	09 36	**3**	10 19	22 05
19	06 17	20 51	**3**	00 33	07 33	**19**	14 58	09 58	**4**	09 55	22 14
20	06 21	20 40	**4**	00 53	07 11	**20**	15 09	10 20	**5**	09 31	22 21
21	−06 24	+20 28	**5**	+01 13	+06 49	**21**	+15 19	−10 41	**6**	+09 06	−22 29
22	06 27	20 16	**6**	01 33	06 27	**22**	15 29	11 02	**7**	08 40	22 36
23	06 29	20 04	**7**	01 53	06 04	**23**	15 37	11 23	**8**	08 15	22 42
24	06 30	19 52	**8**	02 14	05 42	**24**	15 45	11 44	**9**	07 48	22 49
25	06 31	19 39	**9**	02 35	05 19	**25**	15 53	12 05	**10**	07 21	22 54
26	−06 32	+19 26	**10**	+02 56	+04 57	**26**	+15 59	−12 26	**11**	+06 54	−22 59
27	06 32	19 13	**11**	03 17	04 34	**27**	16 05	12 46	**12**	06 26	23 04
28	06 31	18 59	**12**	03 38	04 11	**28**	16 10	13 06	**13**	05 58	23 08
29	06 29	18 45	**13**	03 59	03 48	**29**	16 15	13 26	**14**	05 30	23 12
30	06 27	18 31	**14**	04 21	03 25	**30**	16 19	13 46	**15**	05 01	23 16
31	−06 25	+18 16	**15**	+04 42	+03 02	**31**	+16 22	−14 06	**16**	+04 32	−23 18
Aug. 1	06 21	18 01	**16**	05 03	02 39	**Nov. 1**	16 24	14 25	**17**	04 02	23 21
2	06 17	17 46	**17**	05 25	02 16	**2**	16 25	14 44	**18**	03 33	23 23
3	06 13	17 30	**18**	05 46	01 53	**3**	16 26	15 03	**19**	03 03	23 24
4	06 08	17 14	**19**	06 07	01 29	**4**	16 26	15 22	**20**	02 34	23 25
5	−06 02	+16 58	**20**	+06 29	+01 06	**5**	+16 24	−15 40	**21**	+02 04	−23 26
6	05 55	16 42	**21**	06 50	00 43	**6**	16 23	15 58	**22**	01 34	23 26
7	05 48	16 25	**22**	07 11	+00 20	**7**	16 20	16 16	**23**	01 04	23 26
8	05 41	16 08	**23**	07 32	−00 04	**8**	16 16	16 33	**24**	00 34	23 25
9	05 33	15 51	**24**	07 53	00 27	**9**	16 12	16 51	**25**	+00 04	23 24
10	−05 24	+15 34	**25**	+08 14	−00 51	**10**	+16 07	−17 08	**26**	−00 25	−23 22
11	05 14	15 16	**26**	08 34	01 14	**11**	16 01	17 24	**27**	00 55	23 19
12	05 05	14 58	**27**	08 55	01 37	**12**	15 54	17 41	**28**	01 24	23 17
13	04 54	14 40	**28**	09 15	02 01	**13**	15 46	17 57	**29**	01 54	23 14
14	04 43	14 22	**29**	09 35	02 24	**14**	15 37	18 13	**30**	02 23	23 10
15	−04 32	+14 03	**30**	+09 55	−02 47	**15**	+15 27	−18 28	**31**	−02 51	−23 06
16	−04 20	+13 44	**Oct. 1**	+10 14	−03 11	**16**	+15 17	−18 43	**32**	−03 20	−23 01

$$\text{UT of transit} = 12^h \begin{matrix} - \text{ east} \\ + \text{ west} \end{matrix} \text{ longitude} - \text{equation of time}$$

AT 0^h UNIVERSAL TIME

Date	*Polaris* GHA	σ Oct GHA	Date	*Polaris* GHA	σ Oct GHA	Date	*Polaris* GHA	σ Oct GHA	Date	*Polaris* GHA	σ Oct GHA
	° ′	° ′		° ′	° ′		° ′	° ′		° ′	° ′
Jan. 0	56 13	139 29	**Feb. 15**	101 54	184 50	**Apr. 1**	146 32	229 04	**May 17**	191 54	274 11
1	57 13	140 28	**16**	102 54	185 49	**2**	147 32	230 03	**18**	192 53	275 10
2	58 12	141 27	**17**	103 53	186 49	**3**	148 31	231 02	**19**	193 52	276 09
3	59 12	142 27	**18**	104 53	187 48	**4**	149 30	232 01	**20**	194 51	277 08
4	60 12	143 26	**19**	105 53	188 47	**5**	150 30	232 59	**21**	195 50	278 07
5	61 11	144 25	**20**	106 52	189 46	**6**	151 29	233 58	**22**	196 49	279 05
6	62 11	145 24	**21**	107 52	190 45	**7**	152 28	234 57	**23**	197 48	280 04
7	63 10	146 24	**22**	108 51	191 44	**8**	153 28	235 56	**24**	198 47	281 03
8	64 10	147 23	**23**	109 51	192 43	**9**	154 27	236 55	**25**	199 46	282 02
9	65 09	148 22	**24**	110 50	193 42	**10**	155 26	237 54	**26**	200 45	283 01
10	66 09	149 21	**25**	111 50	194 41	**11**	156 26	238 53	**27**	201 44	284 00
11	67 08	150 21	**26**	112 50	195 40	**12**	157 25	239 52	**28**	202 43	284 58
12	68 08	151 20	**27**	113 49	196 39	**13**	158 24	240 50	**29**	203 42	285 57
13	69 07	152 19	**28**	114 49	197 38	**14**	159 24	241 49	**30**	204 40	286 56
14	70 07	153 18	**Mar. 1**	115 49	198 37	**15**	160 23	242 48	**31**	205 39	287 55
15	71 06	154 17	**2**	116 48	199 36	**16**	161 22	243 47	**June 1**	206 38	288 54
16	72 06	155 17	**3**	117 48	200 35	**17**	162 21	244 46	**2**	207 37	289 53
17	73 06	156 16	**4**	118 47	201 34	**18**	163 20	245 45	**3**	208 36	290 51
18	74 05	157 15	**5**	119 47	202 33	**19**	164 20	246 44	**4**	209 35	291 50
19	75 05	158 14	**6**	120 46	203 32	**20**	165 19	247 42	**5**	210 34	292 49
20	76 04	159 13	**7**	121 46	204 31	**21**	166 18	248 41	**6**	211 33	293 48
21	77 04	160 13	**8**	122 45	205 30	**22**	167 17	249 40	**7**	212 31	294 47
22	78 04	161 12	**9**	123 45	206 29	**23**	168 17	250 39	**8**	213 30	295 46
23	79 03	162 11	**10**	124 44	207 28	**24**	169 16	251 38	**9**	214 29	296 45
24	80 03	163 10	**11**	125 44	208 26	**25**	170 15	252 37	**10**	215 28	297 44
25	81 02	164 09	**12**	126 43	209 25	**26**	171 14	253 36	**11**	216 27	298 42
26	82 02	165 08	**13**	127 43	210 24	**27**	172 13	254 34	**12**	217 25	299 41
27	83 01	166 08	**14**	128 43	211 23	**28**	173 12	255 33	**13**	218 24	300 40
28	84 01	167 07	**15**	129 42	212 22	**29**	174 11	256 32	**14**	219 23	301 39
29	85 01	168 06	**16**	130 42	213 21	**30**	175 11	257 31	**15**	220 22	302 38
30	86 00	169 05	**17**	131 41	214 20	**May 1**	176 10	258 30	**16**	221 21	303 37
31	87 00	170 04	**18**	132 40	215 19	**2**	177 09	259 29	**17**	222 19	304 36
Feb. 1	88 00	171 03	**19**	133 40	216 18	**3**	178 08	260 27	**18**	223 18	305 35
2	88 59	172 02	**20**	134 39	217 17	**4**	179 07	261 26	**19**	224 17	306 33
3	89 59	173 01	**21**	135 39	218 16	**5**	180 06	262 25	**20**	225 16	307 32
4	90 59	174 01	**22**	136 38	219 15	**6**	181 05	263 24	**21**	226 15	308 31
5	91 58	175 00	**23**	137 38	220 14	**7**	182 04	264 23	**22**	227 13	309 30
6	92 58	175 59	**24**	138 37	221 13	**8**	183 03	265 22	**23**	228 12	310 29
7	93 57	176 58	**25**	139 37	222 12	**9**	184 02	266 20	**24**	229 11	311 28
8	94 57	177 57	**26**	140 36	223 10	**10**	185 01	267 19	**25**	230 09	312 27
9	95 56	178 56	**27**	141 35	224 09	**11**	186 00	268 18	**26**	231 08	313 26
10	96 56	179 55	**28**	142 35	225 08	**12**	186 59	269 17	**27**	232 07	314 25
11	97 56	180 54	**29**	143 34	226 07	**13**	187 58	270 16	**28**	233 05	315 23
12	98 55	181 53	**30**	144 34	227 06	**14**	188 57	271 15	**29**	234 04	316 22
13	99 55	182 52	**31**	145 33	228 05	**15**	189 56	272 14	**30**	235 03	317 21
14	100 55	183 51	**Apr. 1**	146 32	229 04	**16**	190 55	273 12	**July 1**	236 02	318 20
15	101 54	184 50	**2**	147 32	230 03	**17**	191 54	274 11	**2**	237 01	319 19

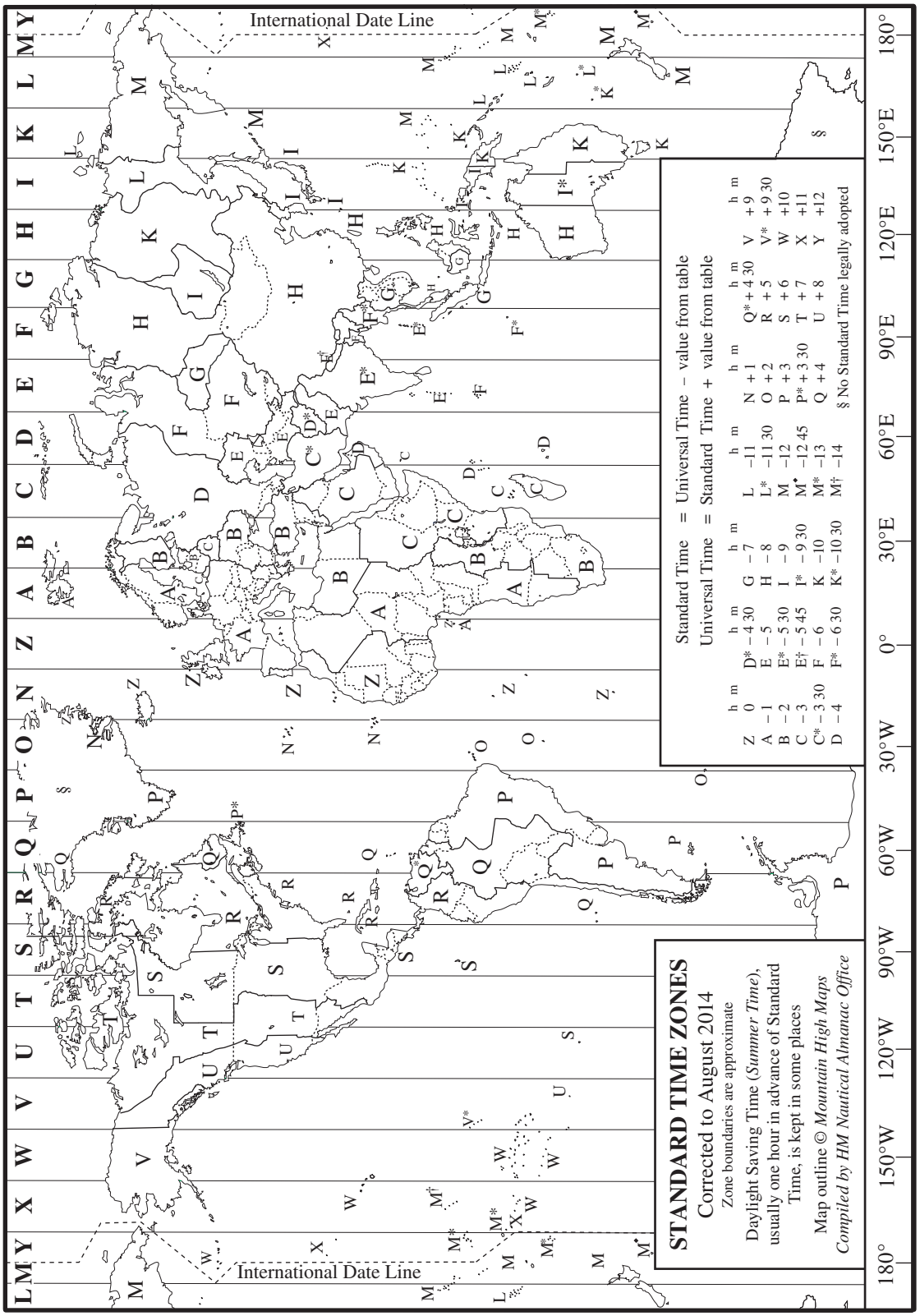
The dates between Jan. 0 and Dec. 32 below are the dates when p changes to the next value.

Polar Distance (p) *Polaris*: Jan. 0 40′ Dec. 21 39′ Dec. 32
σ Octantis: Jan. 0 67′ Dec. 32

AT 0^h UNIVERSAL TIME

Date	*Polaris* GHA	σ Oct GHA	Date	*Polaris* GHA	σ Oct GHA	Date	*Polaris* GHA	σ Oct GHA	Date	*Polaris* GHA	σ Oct GHA
	° ′	° ′		° ′	° ′		° ′	° ′		° ′	° ′
July 1	236 02	318 20	**Aug. 16**	281 00	3 35	**Oct. 1**	326 01	49 00	**Nov. 16**	11 13	94 32
2	237 01	319 19	**17**	281 59	4 34	**2**	327 00	49 59	**17**	12 12	95 31
3	237 59	320 18	**18**	282 57	5 33	**3**	327 59	50 58	**18**	13 11	96 30
4	238 58	321 17	**19**	283 56	6 32	**4**	328 57	51 58	**19**	14 10	97 30
5	239 57	322 16	**20**	284 55	7 31	**5**	329 56	52 57	**20**	15 09	98 29
6	240 55	323 15	**21**	285 53	8 31	**6**	330 55	53 56	**21**	16 09	99 29
7	241 54	324 14	**22**	286 52	9 30	**7**	331 54	54 56	**22**	17 08	100 28
8	242 53	325 13	**23**	287 51	10 29	**8**	332 53	55 55	**23**	18 07	101 28
9	243 51	326 12	**24**	288 49	11 28	**9**	333 52	56 55	**24**	19 06	102 27
10	244 50	327 11	**25**	289 48	12 27	**10**	334 50	57 54	**25**	20 05	103 26
11	245 49	328 10	**26**	290 47	13 26	**11**	335 49	58 53	**26**	21 05	104 26
12	246 47	329 09	**27**	291 45	14 26	**12**	336 48	59 53	**27**	22 04	105 25
13	247 46	330 08	**28**	292 44	15 25	**13**	337 47	60 52	**28**	23 03	106 24
14	248 45	331 06	**29**	293 43	16 24	**14**	338 46	61 51	**29**	24 02	107 24
15	249 43	332 05	**30**	294 41	17 23	**15**	339 45	62 51	**30**	25 02	108 23
16	250 42	333 04	**31**	295 40	18 22	**16**	340 44	63 50	**Dec. 1**	26 01	109 23
17	251 41	334 03	**Sept. 1**	296 39	19 22	**17**	341 43	64 49	**2**	27 00	110 22
18	252 39	335 02	**2**	297 37	20 21	**18**	342 41	65 49	**3**	27 59	111 21
19	253 38	336 01	**3**	298 36	21 20	**19**	343 40	66 48	**4**	28 59	112 21
20	254 37	337 00	**4**	299 35	22 19	**20**	344 39	67 48	**5**	29 58	113 20
21	255 35	337 59	**5**	300 34	23 18	**21**	345 38	68 47	**6**	30 57	114 20
22	256 34	338 58	**6**	301 32	24 18	**22**	346 37	69 46	**7**	31 56	115 19
23	257 32	339 57	**7**	302 31	25 17	**23**	347 36	70 46	**8**	32 56	116 18
24	258 31	340 56	**8**	303 30	26 16	**24**	348 35	71 45	**9**	33 55	117 17
25	259 30	341 55	**9**	304 28	27 15	**25**	349 34	72 45	**10**	34 54	118 17
26	260 29	342 54	**10**	305 27	28 15	**26**	350 33	73 44	**11**	35 54	119 16
27	261 27	343 53	**11**	306 26	29 14	**27**	351 32	74 43	**12**	36 53	120 16
28	262 26	344 52	**12**	307 25	30 13	**28**	352 31	75 43	**13**	37 52	121 15
29	263 25	345 51	**13**	308 23	31 12	**29**	353 30	76 42	**14**	38 52	122 14
30	264 23	346 51	**14**	309 22	32 12	**30**	354 29	77 42	**15**	39 51	123 14
31	265 22	347 50	**15**	310 21	33 11	**31**	355 28	78 41	**16**	40 51	124 13
Aug. 1	266 20	348 49	**16**	311 19	34 10	**Nov. 1**	356 27	79 40	**17**	41 50	125 12
2	267 19	349 48	**17**	312 18	35 09	**2**	357 26	80 40	**18**	42 49	126 12
3	268 18	350 47	**18**	313 17	36 09	**3**	358 25	81 39	**19**	43 49	127 11
4	269 16	351 46	**19**	314 16	37 08	**4**	359 24	82 39	**20**	44 48	128 10
5	270 15	352 45	**20**	315 14	38 07	**5**	0 23	83 38	**21**	45 47	129 10
6	271 14	353 44	**21**	316 13	39 06	**6**	1 22	84 38	**22**	46 47	130 09
7	272 12	354 43	**22**	317 12	40 06	**7**	2 21	85 37	**23**	47 46	131 08
8	273 11	355 42	**23**	318 11	41 05	**8**	3 20	86 36	**24**	48 46	132 08
9	274 10	356 41	**24**	319 09	42 04	**9**	4 19	87 36	**25**	49 45	133 07
10	275 08	357 40	**25**	320 08	43 04	**10**	5 18	88 35	**26**	50 45	134 06
11	276 07	358 39	**26**	321 07	44 03	**11**	6 17	89 35	**27**	51 44	135 05
12	277 06	359 38	**27**	322 06	45 02	**12**	7 16	90 34	**28**	52 44	136 05
13	278 04	0 38	**28**	323 04	46 02	**13**	8 15	91 33	**29**	53 43	137 04
14	279 03	1 37	**29**	324 03	47 01	**14**	9 15	92 33	**30**	54 43	138 03
15	280 02	2 36	**30**	325 02	48 00	**15**	10 14	93 32	**31**	55 42	139 03
16	281 00	3 35	**Oct. 1**	326 01	49 00	**16**	11 13	94 32	**32**	56 41	140 02

Form the quantities $C = p \cos$ (local hour angle) and $S = p \sin$ (local hour angle) then
Latitude $= h_0 - C + 0{\cdot}0087\, S^2 \tan h_0$,
Azimuth of *Polaris* $= -S/\cos h_0$ and Azimuth of σ Octantis $= 180^\circ + S/\cos h_0$, where p and h_0 are in degrees and h_0 is the observed altitude corrected for atmospheric refraction and instrument error.


International Date Line
International Date Line
STANDARD TIME ZONES
Corrected to August 2014
Zone boundaries are approximate
Daylight Saving Time (Summer Time), usually one hour in advance of Standard Time, is kept in some places
Map outline © Mountain High Maps
Compiled by HM Nautical Almanac Office
Standard Time = Universal Time – value from table
Universal Time = Standard Time + value from table
Z 0 | D* – 4 30 | G – 7 | L –11 | N + 1 | Q* + 4 30 | V + 9
A – 1 | E – 5 | H – 8 | L* –11 30 | O + 2 | R + 5 | V* + 9 30
B – 2 | E* – 5 30 | I – 9 | M –12 | P + 3 | S + 6 | W + 10
C – 3 | E† – 5 45 | I* – 9 30 | M• –12 45 | P* + 3 30 | T + 7 | X + 11
C* – 3 30 | F – 6 | K –10 | M* –13 | Q + 4 | U + 8 | Y + 12
D – 4 | F* – 6 30 | K* –10 30 | M† –14 | § No Standard Time legally adopted
180° 150°W 120°W 90°W 60°W 30°W 0° 30°E 60°E 90°E 120°E 150°E 180°

The times of sunrise and sunset (pages 24–31) and of moonrise and moonset (pages 32–63) are the instants when the upper limbs of the Sun and Moon appear to lie on the horizon for an observer at sea-level. In both cases a fixed allowance of 34′ has been made for refraction; a further allowance of 16′ has been made for the semidiameter of the Sun, while for the Moon the actual value of semidiameter *minus* horizontal parallax has been used. No allowance has been made for the phase of the Moon. The observed times may differ from the tabular times because of variations in refraction and the relative heights of the observer and horizon.

The tabular values are for the universal time (UT) of the phenomena on the Greenwich meridian (longitude 0°). To a first approximation the UT at another longitude is given by subtracting the longitude, expressed in time-measure, if east of Greenwich, or by adding, if west of Greenwich. Alternatively the tables may be regarded as giving the approximate local mean time on all meridians. These times may be converted to standard time by applying the appropriate differences, as indicated in the note on page 4. Linear interpolation may be used to obtain the times for non-tabular latitudes.

In the case of the Sun it may be necessary to interpolate (mentally) to obtain the UT for an intermediate date, but a further interpolation for longitude is not normally required. In the case of the Moon the values must normally be interpolated for longitude, as well as for latitude, since the changes in the tabular values from one day to the next are usually large. The interpolating factor is equal to one twenty-fourth of the longitude if expressed in hours and decimals of an hour; linear interpolation is usually adequate.

Example

To find the times of sunrise and sunset and of moonrise and moonset on 2017 February 10 at latitude N 38° 55′, longitude W 77° 15′. The longitude expressed in time-measure is W $05^{h}\ 09^{m}$. The difference between standard time and UT is -5^{h} in this case.

The relevant tabular values in UT for longitude 0° are as follows:

	Sunrise		Sunset			Moonrise		Moonset	
	+35°	+40°	+35°	+40°		+35°	+40°	+35°	+40°
d	h m	h m	h m	h m	d	h m	h m	h m	h m
Feb. 7	06 54	07 02	17 35	17 26	**Feb. 10**	17 18	17 09	06 17	06 26
11	06 50	06 58	17 39	17 31	**11**	18 21	18 14	07 01	07 08

Interpolating factor for latitude is 3° 55′/ 5° = 0·78
for date for Sun is $3^{d}/4^{d}$ = 0·75
for long. for Moon is $5^{h}\cdot15/24^{h}$ = 0·21

	Sunrise		Sunset		Moonrise		Moonset	
Interpolation to:	d	h m	h m		d	h m	h m	
Latitude N 38° 55′	**Feb. 7**	07 00	17 28		**Feb. 10**	17 11	06 24	
N 38° 55′	**11**	06 56	17 33		**11**	18 16	07 06	
Local mean time	**10**	06 57	17 32		**10**	17 25	06 33	
Adjustment to:								
Universal time	**10**	12 06	22 41		**10**	22 34	11 42	
Standard time	**10**	07 06	17 41		**10**	17 34	06 42	

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. −2	3 23	3 53	4 15	4 33	4 48	5 00	5 22	5 41	5 58	6 16	6 34	6 55	7 07	7 21
2	3 28	3 57	4 18	4 36	4 51	5 03	5 25	5 43	6 00	6 17	6 36	6 56	7 08	7 22
6	3 33	4 01	4 22	4 40	4 54	5 06	5 27	5 45	6 02	6 19	6 37	6 57	7 09	7 22
10	3 39	4 06	4 27	4 44	4 57	5 09	5 30	5 48	6 04	6 20	6 37	6 57	7 08	7 21
14	3 46	4 12	4 32	4 48	5 01	5 13	5 33	5 50	6 05	6 21	6 38	6 57	7 08	7 20
18	3 54	4 18	4 37	4 52	5 05	5 16	5 35	5 52	6 07	6 22	6 38	6 56	7 07	7 19
22	4 02	4 25	4 43	4 57	5 09	5 20	5 38	5 54	6 08	6 22	6 38	6 55	7 05	7 16
26	4 10	4 32	4 48	5 02	5 13	5 23	5 41	5 55	6 09	6 23	6 37	6 53	7 03	7 14
30	4 19	4 38	4 54	5 07	5 18	5 27	5 43	5 57	6 10	6 23	6 36	6 51	7 00	7 10
Feb. 3	4 27	4 45	5 00	5 12	5 22	5 30	5 45	5 58	6 10	6 22	6 35	6 49	6 57	7 06
7	4 36	4 53	5 06	5 17	5 26	5 34	5 48	6 00	6 11	6 22	6 33	6 46	6 54	7 02
11	4 45	5 00	5 12	5 21	5 30	5 37	5 50	6 01	6 11	6 21	6 31	6 43	6 50	6 58
15	4 53	5 07	5 17	5 26	5 34	5 40	5 52	6 02	6 11	6 20	6 29	6 40	6 46	6 53
19	5 02	5 14	5 23	5 31	5 38	5 44	5 54	6 02	6 10	6 18	6 27	6 36	6 41	6 48
23	5 10	5 21	5 29	5 36	5 42	5 47	5 55	6 03	6 10	6 17	6 24	6 32	6 37	6 42
27	5 19	5 27	5 34	5 40	5 45	5 50	5 57	6 03	6 09	6 15	6 21	6 28	6 32	6 36
Mar. 3	5 27	5 34	5 40	5 45	5 49	5 52	5 58	6 04	6 09	6 13	6 18	6 24	6 27	6 30
7	5 35	5 41	5 45	5 49	5 52	5 55	6 00	6 04	6 08	6 11	6 15	6 19	6 21	6 24
11	5 43	5 47	5 51	5 53	5 56	5 58	6 01	6 04	6 07	6 09	6 12	6 15	6 16	6 18
15	5 51	5 54	5 56	5 58	5 59	6 00	6 02	6 04	6 06	6 07	6 08	6 10	6 11	6 11
19	5 59	6 00	6 01	6 02	6 02	6 03	6 04	6 04	6 04	6 05	6 05	6 05	6 05	6 05
23	6 07	6 07	6 06	6 06	6 06	6 05	6 05	6 04	6 03	6 02	6 01	6 00	5 59	5 58
27	6 15	6 13	6 11	6 10	6 09	6 08	6 06	6 04	6 02	6 00	5 58	5 55	5 54	5 52
31	6 23	6 19	6 16	6 14	6 12	6 10	6 07	6 04	6 01	5 58	5 54	5 51	5 48	5 46
Apr. 4	6 30	6 25	6 21	6 18	6 15	6 13	6 08	6 04	6 00	5 56	5 51	5 46	5 43	5 39

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. −2	20 41	20 12	19 49	19 32	19 17	19 04	18 42	18 23	18 06	17 49	17 30	17 09	16 57	16 43
2	20 40	20 11	19 50	19 32	19 18	19 05	18 43	18 25	18 08	17 51	17 33	17 12	17 00	16 46
6	20 38	20 10	19 49	19 32	19 18	19 05	18 44	18 26	18 10	17 53	17 35	17 15	17 04	16 50
10	20 35	20 08	19 48	19 31	19 17	19 06	18 45	18 28	18 11	17 55	17 38	17 18	17 07	16 54
14	20 31	20 05	19 46	19 30	19 17	19 05	18 45	18 29	18 13	17 57	17 41	17 22	17 11	16 58
18	20 26	20 02	19 43	19 28	19 15	19 04	18 45	18 29	18 14	17 59	17 43	17 25	17 15	17 03
22	20 20	19 58	19 40	19 26	19 14	19 03	18 45	18 30	18 15	18 01	17 46	17 29	17 19	17 07
26	20 14	19 53	19 36	19 23	19 11	19 01	18 44	18 30	18 16	18 03	17 48	17 32	17 23	17 12
30	20 07	19 47	19 32	19 19	19 09	18 59	18 43	18 30	18 17	18 04	17 51	17 36	17 27	17 17
Feb. 3	19 59	19 41	19 27	19 15	19 05	18 57	18 42	18 29	18 17	18 06	17 53	17 39	17 31	17 22
7	19 51	19 35	19 22	19 11	19 02	18 54	18 40	18 29	18 18	18 07	17 55	17 42	17 35	17 26
11	19 42	19 28	19 16	19 06	18 58	18 51	18 38	18 28	18 18	18 08	17 57	17 46	17 39	17 31
15	19 34	19 20	19 10	19 01	18 54	18 47	18 36	18 26	18 17	18 09	17 59	17 49	17 43	17 36
19	19 24	19 13	19 03	18 56	18 49	18 43	18 34	18 25	18 17	18 09	18 01	17 52	17 47	17 41
23	19 15	19 05	18 57	18 50	18 44	18 39	18 31	18 23	18 17	18 10	18 03	17 55	17 50	17 45
27	19 05	18 57	18 50	18 44	18 39	18 35	18 28	18 22	18 16	18 10	18 04	17 58	17 54	17 50
Mar. 3	18 55	18 48	18 43	18 38	18 34	18 31	18 25	18 20	18 15	18 11	18 06	18 01	17 57	17 54
7	18 45	18 40	18 36	18 32	18 29	18 26	18 22	18 18	18 14	18 11	18 07	18 03	18 01	17 58
11	18 35	18 31	18 28	18 26	18 24	18 22	18 18	18 16	18 13	18 11	18 08	18 06	18 04	18 03
15	18 25	18 23	18 21	18 19	18 18	18 17	18 15	18 13	18 12	18 11	18 10	18 08	18 08	18 07
19	18 15	18 14	18 13	18 13	18 12	18 12	18 12	18 11	18 11	18 11	18 11	18 11	18 11	18 11
23	18 05	18 05	18 06	18 06	18 07	18 07	18 08	18 09	18 10	18 11	18 12	18 13	18 14	18 15
27	17 55	17 57	17 58	18 00	18 01	18 02	18 05	18 07	18 09	18 11	18 13	18 16	18 17	18 19
31	17 44	17 48	17 51	17 53	17 56	17 58	18 01	18 04	18 07	18 11	18 14	18 18	18 21	18 23
Apr. 4	17 34	17 40	17 44	17 47	17 50	17 53	17 58	18 02	18 06	18 10	18 15	18 21	18 24	18 27

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. −2	7 21	7 28	7 34	7 42	7 50	7 58	8 08	8 19	8 32	8 46	9 03	9 24	9 52	10 32
2	7 22	7 28	7 35	7 42	7 50	7 58	8 08	8 19	8 31	8 45	9 02	9 22	9 48	10 25
6	7 22	7 28	7 35	7 42	7 49	7 57	8 07	8 17	8 29	8 43	8 59	9 18	9 43	10 17
10	7 21	7 27	7 34	7 40	7 48	7 56	8 05	8 15	8 26	8 39	8 54	9 13	9 36	10 07
14	7 20	7 26	7 32	7 38	7 46	7 53	8 02	8 11	8 22	8 34	8 49	9 06	9 27	9 55
18	7 19	7 24	7 30	7 36	7 43	7 50	7 58	8 07	8 17	8 29	8 42	8 58	9 18	9 43
22	7 16	7 21	7 27	7 33	7 39	7 46	7 54	8 02	8 12	8 22	8 35	8 50	9 08	9 30
26	7 14	7 18	7 23	7 29	7 35	7 41	7 49	7 56	8 05	8 15	8 27	8 40	8 56	9 16
30	7 10	7 15	7 19	7 25	7 30	7 36	7 43	7 50	7 58	8 07	8 18	8 30	8 45	9 03
Feb. 3	7 06	7 11	7 15	7 20	7 25	7 30	7 36	7 43	7 51	7 59	8 09	8 20	8 33	8 48
7	7 02	7 06	7 10	7 14	7 19	7 24	7 30	7 36	7 42	7 50	7 59	8 09	8 20	8 34
11	6 58	7 01	7 05	7 09	7 13	7 17	7 22	7 28	7 34	7 41	7 48	7 57	8 07	8 19
15	6 53	6 56	6 59	7 03	7 06	7 10	7 15	7 20	7 25	7 31	7 38	7 45	7 54	8 05
19	6 48	6 50	6 53	6 56	6 59	7 03	7 07	7 11	7 16	7 21	7 27	7 33	7 41	7 50
23	6 42	6 44	6 47	6 49	6 52	6 55	6 58	7 02	7 06	7 10	7 15	7 21	7 27	7 35
27	6 36	6 38	6 40	6 42	6 45	6 47	6 50	6 53	6 56	7 00	7 04	7 08	7 14	7 20
Mar. 3	6 30	6 32	6 33	6 35	6 37	6 39	6 41	6 44	6 46	6 49	6 52	6 56	7 00	7 05
7	6 24	6 25	6 26	6 28	6 29	6 31	6 32	6 34	6 36	6 38	6 40	6 43	6 46	6 50
11	6 18	6 19	6 19	6 20	6 21	6 22	6 23	6 24	6 26	6 27	6 28	6 30	6 32	6 34
15	6 11	6 12	6 12	6 13	6 13	6 13	6 14	6 15	6 15	6 16	6 16	6 17	6 18	6 19
19	6 05	6 05	6 05	6 05	6 05	6 05	6 05	6 05	6 05	6 04	6 04	6 04	6 04	6 04
23	5 58	5 58	5 58	5 57	5 57	5 56	5 55	5 55	5 54	5 53	5 52	5 51	5 50	5 48
27	5 52	5 51	5 50	5 49	5 48	5 47	5 46	5 45	5 43	5 42	5 40	5 38	5 36	5 33
31	5 46	5 44	5 43	5 42	5 40	5 39	5 37	5 35	5 33	5 31	5 28	5 25	5 22	5 18
Apr. 4	5 39	5 38	5 36	5 34	5 32	5 30	5 28	5 25	5 22	5 19	5 16	5 12	5 07	5 02

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. −2	16 43	16 37	16 30	16 23	16 15	16 06	15 56	15 45	15 33	15 19	15 01	14 40	14 13	13 33
2	16 46	16 40	16 34	16 26	16 19	16 10	16 01	15 50	15 38	15 24	15 07	14 47	14 20	13 43
6	16 50	16 44	16 38	16 31	16 23	16 15	16 05	15 55	15 43	15 30	15 14	14 54	14 30	13 55
10	16 54	16 48	16 42	16 35	16 28	16 20	16 11	16 01	15 50	15 37	15 21	15 03	14 40	14 09
14	16 58	16 53	16 47	16 40	16 33	16 25	16 17	16 07	15 57	15 44	15 30	15 13	14 52	14 24
18	17 03	16 57	16 52	16 45	16 39	16 31	16 23	16 14	16 04	15 53	15 39	15 23	15 04	14 39
22	17 07	17 02	16 57	16 51	16 45	16 38	16 30	16 22	16 12	16 01	15 49	15 34	15 16	14 54
26	17 12	17 07	17 02	16 57	16 51	16 44	16 37	16 29	16 21	16 11	15 59	15 46	15 30	15 10
30	17 17	17 12	17 08	17 03	16 57	16 51	16 44	16 37	16 29	16 20	16 09	15 57	15 43	15 25
Feb. 3	17 22	17 18	17 13	17 09	17 03	16 58	16 52	16 45	16 38	16 29	16 20	16 09	15 56	15 40
7	17 26	17 23	17 19	17 14	17 10	17 05	16 59	16 53	16 47	16 39	16 30	16 21	16 09	15 55
11	17 31	17 28	17 24	17 20	17 16	17 12	17 07	17 01	16 55	16 49	16 41	16 32	16 22	16 10
15	17 36	17 33	17 30	17 26	17 23	17 19	17 14	17 09	17 04	16 58	16 52	16 44	16 35	16 25
19	17 41	17 38	17 35	17 32	17 29	17 25	17 22	17 17	17 13	17 08	17 02	16 55	16 48	16 39
23	17 45	17 43	17 41	17 38	17 35	17 32	17 29	17 25	17 22	17 17	17 12	17 07	17 00	16 53
27	17 50	17 48	17 46	17 44	17 41	17 39	17 36	17 33	17 30	17 27	17 23	17 18	17 13	17 07
Mar. 3	17 54	17 53	17 51	17 49	17 48	17 46	17 44	17 41	17 39	17 36	17 33	17 29	17 25	17 21
7	17 58	17 57	17 56	17 55	17 54	17 52	17 51	17 49	17 47	17 45	17 43	17 40	17 37	17 34
11	18 03	18 02	18 01	18 00	18 00	17 59	17 58	17 57	17 55	17 54	17 53	17 51	17 49	17 47
15	18 07	18 07	18 06	18 06	18 06	18 05	18 05	18 04	18 04	18 03	18 03	18 02	18 01	18 00
19	18 11	18 11	18 11	18 11	18 11	18 12	18 12	18 12	18 12	18 12	18 12	18 13	18 13	18 13
23	18 15	18 16	18 16	18 17	18 17	18 18	18 19	18 19	18 20	18 21	18 22	18 23	18 25	18 26
27	18 19	18 20	18 21	18 22	18 23	18 24	18 25	18 27	18 28	18 30	18 32	18 34	18 37	18 40
31	18 23	18 25	18 26	18 27	18 29	18 30	18 32	18 34	18 37	18 39	18 42	18 45	18 48	18 53
Apr. 4	18 27	18 29	18 31	18 33	18 35	18 37	18 39	18 42	18 45	18 48	18 51	18 56	19 00	19 06

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 31	6 23	6 19	6 16	6 14	6 12	6 10	6 07	6 04	6 01	5 58	5 54	5 51	5 48	5 46
Apr. 4	6 30	6 25	6 21	6 18	6 15	6 13	6 08	6 04	6 00	5 56	5 51	5 46	5 43	5 39
8	6 38	6 32	6 26	6 22	6 18	6 15	6 09	6 04	5 59	5 53	5 48	5 41	5 37	5 33
12	6 46	6 38	6 31	6 26	6 21	6 17	6 10	6 04	5 57	5 51	5 44	5 36	5 32	5 27
16	6 53	6 44	6 36	6 30	6 25	6 20	6 11	6 04	5 56	5 49	5 41	5 32	5 27	5 21
20	7 01	6 50	6 41	6 34	6 28	6 22	6 12	6 04	5 56	5 47	5 38	5 28	5 22	5 15
24	7 09	6 56	6 46	6 38	6 31	6 25	6 14	6 04	5 55	5 45	5 35	5 24	5 17	5 09
28	7 16	7 02	6 51	6 42	6 34	6 27	6 15	6 04	5 54	5 44	5 33	5 20	5 12	5 04
May 2	7 24	7 08	6 56	6 46	6 37	6 30	6 16	6 05	5 54	5 42	5 30	5 16	5 08	4 59
6	7 31	7 14	7 01	6 50	6 40	6 32	6 18	6 05	5 53	5 41	5 28	5 13	5 04	4 54
10	7 38	7 20	7 06	6 54	6 44	6 35	6 19	6 06	5 53	5 40	5 26	5 10	5 00	4 50
14	7 45	7 25	7 10	6 58	6 47	6 37	6 21	6 06	5 53	5 39	5 24	5 07	4 57	4 46
18	7 52	7 31	7 15	7 01	6 50	6 40	6 22	6 07	5 53	5 38	5 23	5 05	4 54	4 42
22	7 58	7 36	7 19	7 05	6 53	6 42	6 24	6 08	5 53	5 38	5 22	5 03	4 52	4 39
26	8 04	7 41	7 23	7 08	6 55	6 44	6 26	6 09	5 53	5 38	5 21	5 01	4 50	4 36
30	8 09	7 45	7 26	7 11	6 58	6 47	6 27	6 10	5 54	5 38	5 20	5 00	4 48	4 34
June 3	8 14	7 49	7 30	7 14	7 00	6 49	6 29	6 11	5 55	5 38	5 20	4 59	4 47	4 32
7	8 18	7 53	7 33	7 16	7 03	6 51	6 30	6 12	5 55	5 38	5 20	4 58	4 46	4 31
11	8 22	7 55	7 35	7 18	7 05	6 52	6 31	6 13	5 56	5 39	5 20	4 58	4 45	4 31
15	8 25	7 58	7 37	7 20	7 06	6 54	6 33	6 14	5 57	5 39	5 20	4 58	4 46	4 31
19	8 26	7 59	7 38	7 22	7 07	6 55	6 34	6 15	5 58	5 40	5 21	4 59	4 46	4 31
23	8 27	8 00	7 39	7 22	7 08	6 56	6 35	6 16	5 59	5 41	5 22	5 00	4 47	4 32
27	8 27	8 00	7 39	7 23	7 09	6 56	6 35	6 17	5 59	5 42	5 23	5 01	4 48	4 33
July 1	8 26	7 59	7 39	7 23	7 09	6 57	6 36	6 17	6 00	5 43	5 24	5 03	4 50	4 35
5	8 24	7 58	7 38	7 22	7 08	6 56	6 36	6 18	6 01	5 44	5 26	5 04	4 52	4 37

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 31	17 44	17 48	17 51	17 53	17 56	17 58	18 01	18 04	18 07	18 11	18 14	18 18	18 21	18 23
Apr. 4	17 34	17 40	17 44	17 47	17 50	17 53	17 58	18 02	18 06	18 10	18 15	18 21	18 24	18 27
8	17 25	17 31	17 36	17 41	17 45	17 48	17 54	18 00	18 05	18 10	18 16	18 23	18 27	18 31
12	17 15	17 23	17 29	17 35	17 40	17 44	17 51	17 58	18 04	18 10	18 17	18 25	18 30	18 35
16	17 05	17 15	17 22	17 29	17 34	17 39	17 48	17 56	18 03	18 11	18 19	18 28	18 33	18 40
20	16 56	17 07	17 16	17 23	17 29	17 35	17 45	17 54	18 02	18 11	18 20	18 30	18 37	18 44
24	16 47	16 59	17 09	17 18	17 25	17 31	17 42	17 52	18 01	18 11	18 21	18 33	18 40	18 48
28	16 38	16 52	17 03	17 12	17 20	17 27	17 40	17 51	18 01	18 11	18 23	18 35	18 43	18 52
May 2	16 30	16 45	16 57	17 07	17 16	17 24	17 37	17 49	18 00	18 12	18 24	18 38	18 46	18 56
6	16 22	16 38	16 52	17 03	17 12	17 21	17 35	17 48	18 00	18 12	18 25	18 41	18 50	19 00
10	16 14	16 32	16 47	16 59	17 09	17 18	17 33	17 47	18 00	18 13	18 27	18 43	18 53	19 04
14	16 07	16 27	16 42	16 55	17 06	17 15	17 32	17 46	18 00	18 14	18 29	18 46	18 56	19 08
18	16 01	16 22	16 38	16 51	17 03	17 13	17 30	17 46	18 00	18 15	18 30	18 48	18 59	19 11
22	15 55	16 17	16 34	16 48	17 00	17 11	17 29	17 45	18 00	18 15	18 32	18 51	19 02	19 15
26	15 50	16 13	16 31	16 46	16 58	17 09	17 28	17 45	18 01	18 16	18 33	18 53	19 05	19 18
30	15 45	16 10	16 28	16 44	16 57	17 08	17 28	17 45	18 01	18 18	18 35	18 56	19 08	19 21
June 3	15 42	16 07	16 26	16 42	16 56	17 07	17 28	17 45	18 02	18 19	18 37	18 58	19 10	19 24
7	15 39	16 05	16 25	16 41	16 55	17 07	17 28	17 46	18 03	18 20	18 38	19 00	19 12	19 27
11	15 37	16 04	16 24	16 41	16 55	17 07	17 28	17 46	18 03	18 21	18 39	19 01	19 14	19 29
15	15 36	16 03	16 24	16 41	16 55	17 07	17 28	17 47	18 04	18 22	18 41	19 03	19 16	19 31
19	15 36	16 04	16 24	16 41	16 55	17 08	17 29	17 48	18 05	18 23	18 42	19 04	19 17	19 32
23	15 37	16 05	16 25	16 42	16 56	17 09	17 30	17 48	18 06	18 24	18 43	19 05	19 18	19 33
27	15 39	16 06	16 27	16 44	16 58	17 10	17 31	17 49	18 07	18 24	18 43	19 05	19 18	19 33
July 1	15 42	16 08	16 29	16 45	16 59	17 11	17 32	17 50	18 08	18 25	18 44	19 05	19 18	19 33
5	15 46	16 11	16 31	16 47	17 01	17 13	17 34	17 51	18 08	18 25	18 44	19 05	19 17	19 32

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 31	5 46	5 44	5 43	5 42	5 40	5 39	5 37	5 35	5 33	5 31	5 28	5 25	5 22	5 18
Apr. 4	5 39	5 38	5 36	5 34	5 32	5 30	5 28	5 25	5 22	5 19	5 16	5 12	5 07	5 02
8	5 33	5 31	5 29	5 27	5 24	5 22	5 19	5 16	5 12	5 08	5 04	4 59	4 53	4 47
12	5 27	5 24	5 22	5 19	5 16	5 13	5 10	5 06	5 02	4 57	4 52	4 46	4 39	4 31
16	5 21	5 18	5 15	5 12	5 09	5 05	5 01	4 57	4 52	4 46	4 40	4 33	4 25	4 16
20	5 15	5 12	5 08	5 05	5 01	4 57	4 52	4 47	4 42	4 36	4 29	4 20	4 11	4 00
24	5 09	5 06	5 02	4 58	4 54	4 49	4 44	4 38	4 32	4 25	4 17	4 08	3 57	3 44
28	5 04	5 00	4 56	4 52	4 47	4 42	4 36	4 30	4 23	4 15	4 06	3 55	3 43	3 29
May 2	4 59	4 55	4 50	4 45	4 40	4 34	4 28	4 21	4 14	4 05	3 55	3 43	3 30	3 13
6	4 54	4 50	4 45	4 40	4 34	4 28	4 21	4 13	4 05	3 55	3 44	3 31	3 16	2 57
10	4 50	4 45	4 40	4 34	4 28	4 21	4 14	4 06	3 57	3 46	3 34	3 20	3 03	2 41
14	4 46	4 41	4 35	4 29	4 22	4 15	4 08	3 59	3 49	3 38	3 24	3 09	2 50	2 26
18	4 42	4 37	4 31	4 24	4 18	4 10	4 02	3 52	3 42	3 29	3 15	2 58	2 37	2 10
22	4 39	4 33	4 27	4 20	4 13	4 05	3 56	3 46	3 35	3 22	3 07	2 48	2 25	1 53
26	4 36	4 30	4 24	4 17	4 09	4 01	3 52	3 41	3 29	3 15	2 59	2 39	2 13	1 37
30	4 34	4 28	4 21	4 14	4 06	3 57	3 48	3 37	3 24	3 10	2 52	2 31	2 03	1 20
June 3	4 32	4 26	4 19	4 12	4 03	3 54	3 44	3 33	3 20	3 05	2 46	2 23	1 53	1 03
7	4 31	4 25	4 18	4 10	4 02	3 52	3 42	3 30	3 17	3 01	2 42	2 18	1 44	0 44
11	4 31	4 24	4 17	4 09	4 00	3 51	3 40	3 28	3 14	2 58	2 38	2 13	1 38	0 20
15	4 31	4 24	4 17	4 09	4 00	3 50	3 39	3 27	3 13	2 56	2 36	2 10	1 33	▭
19	4 31	4 24	4 17	4 09	4 00	3 50	3 39	3 27	3 13	2 56	2 36	2 09	1 31	▭
23	4 32	4 25	4 18	4 10	4 01	3 51	3 40	3 28	3 14	2 57	2 36	2 10	1 32	▭
27	4 33	4 26	4 19	4 11	4 02	3 53	3 42	3 30	3 16	2 59	2 39	2 13	1 35	▭
July 1	4 35	4 28	4 21	4 13	4 05	3 55	3 44	3 32	3 18	3 02	2 42	2 17	1 41	0 21
5	4 37	4 31	4 23	4 16	4 07	3 58	3 48	3 36	3 22	3 06	2 47	2 23	1 50	0 48

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 31	18 23	18 25	18 26	18 27	18 29	18 30	18 32	18 34	18 37	18 39	18 42	18 45	18 48	18 53
Apr. 4	18 27	18 29	18 31	18 33	18 35	18 37	18 39	18 42	18 45	18 48	18 51	18 56	19 00	19 06
8	18 31	18 33	18 36	18 38	18 40	18 43	18 46	18 49	18 53	18 57	19 01	19 06	19 12	19 19
12	18 35	18 38	18 40	18 43	18 46	18 49	18 53	18 57	19 01	19 06	19 11	19 17	19 24	19 33
16	18 40	18 42	18 45	18 48	18 52	18 56	19 00	19 04	19 09	19 15	19 21	19 28	19 36	19 46
20	18 44	18 47	18 50	18 54	18 58	19 02	19 06	19 12	19 17	19 24	19 31	19 39	19 49	20 00
24	18 48	18 51	18 55	18 59	19 03	19 08	19 13	19 19	19 25	19 33	19 41	19 50	20 01	20 14
28	18 52	18 56	19 00	19 04	19 09	19 14	19 20	19 26	19 34	19 42	19 51	20 01	20 14	20 29
May 2	18 56	19 00	19 05	19 09	19 15	19 20	19 27	19 34	19 42	19 51	20 01	20 13	20 27	20 44
6	19 00	19 04	19 09	19 15	19 20	19 26	19 33	19 41	19 50	19 59	20 11	20 24	20 39	20 59
10	19 04	19 09	19 14	19 20	19 26	19 32	19 40	19 48	19 57	20 08	20 20	20 35	20 52	21 14
14	19 08	19 13	19 18	19 24	19 31	19 38	19 46	19 55	20 05	20 17	20 30	20 46	21 05	21 30
18	19 11	19 17	19 23	19 29	19 36	19 44	19 52	20 02	20 12	20 25	20 39	20 57	21 18	21 47
22	19 15	19 21	19 27	19 34	19 41	19 49	19 58	20 08	20 19	20 33	20 48	21 07	21 31	22 03
26	19 18	19 24	19 31	19 38	19 45	19 54	20 03	20 14	20 26	20 40	20 57	21 17	21 43	22 21
30	19 21	19 28	19 34	19 42	19 50	19 58	20 08	20 19	20 32	20 47	21 04	21 26	21 55	22 39
June 3	19 24	19 31	19 38	19 45	19 53	20 02	20 13	20 24	20 37	20 53	21 11	21 34	22 06	22 58
7	19 27	19 33	19 40	19 48	19 57	20 06	20 16	20 28	20 42	20 58	21 17	21 41	22 15	23 19
11	19 29	19 36	19 43	19 51	19 59	20 09	20 19	20 32	20 45	21 02	21 22	21 47	22 23	23 49
15	19 31	19 37	19 45	19 53	20 01	20 11	20 22	20 34	20 48	21 05	21 25	21 51	22 29	▭
19	19 32	19 39	19 46	19 54	20 03	20 12	20 23	20 36	20 50	21 07	21 27	21 54	22 32	▭
23	19 33	19 39	19 47	19 55	20 04	20 13	20 24	20 36	20 51	21 07	21 28	21 54	22 32	▭
27	19 33	19 40	19 47	19 55	20 04	20 13	20 24	20 36	20 50	21 07	21 27	21 53	22 30	▭
July 1	19 33	19 39	19 47	19 54	20 03	20 12	20 23	20 35	20 49	21 05	21 25	21 50	22 25	23 39
5	19 32	19 38	19 46	19 53	20 02	20 11	20 21	20 33	20 46	21 02	21 21	21 45	22 18	23 16

▭ indicates Sun continuously above horizon.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 1	8 26	7 59	7 39	7 23	7 09	6 57	6 36	6 17	6 00	5 43	5 24	5 03	4 50	4 35
5	8 24	7 58	7 38	7 22	7 08	6 56	6 36	6 18	6 01	5 44	5 26	5 04	4 52	4 37
9	8 21	7 56	7 37	7 21	7 07	6 56	6 36	6 18	6 02	5 45	5 27	5 06	4 54	4 40
13	8 17	7 53	7 34	7 19	7 06	6 55	6 35	6 18	6 02	5 46	5 28	5 08	4 56	4 42
17	8 13	7 50	7 32	7 17	7 04	6 54	6 35	6 18	6 03	5 47	5 30	5 10	4 59	4 45
21	8 08	7 46	7 28	7 14	7 02	6 52	6 34	6 18	6 03	5 48	5 31	5 13	5 01	4 49
25	8 02	7 41	7 25	7 11	7 00	6 50	6 33	6 17	6 03	5 49	5 33	5 15	5 04	4 52
29	7 55	7 36	7 20	7 08	6 57	6 47	6 31	6 17	6 03	5 49	5 34	5 17	5 07	4 56
Aug. 2	7 48	7 30	7 15	7 04	6 54	6 45	6 29	6 16	6 03	5 50	5 36	5 20	5 10	4 59
6	7 40	7 23	7 10	6 59	6 50	6 42	6 27	6 14	6 02	5 50	5 37	5 22	5 13	5 03
10	7 32	7 17	7 05	6 54	6 46	6 38	6 25	6 13	6 02	5 51	5 38	5 24	5 16	5 07
14	7 23	7 10	6 59	6 49	6 41	6 34	6 22	6 11	6 01	5 51	5 40	5 27	5 19	5 11
18	7 15	7 02	6 52	6 44	6 37	6 31	6 19	6 10	6 00	5 51	5 41	5 29	5 22	5 14
22	7 05	6 55	6 46	6 38	6 32	6 26	6 17	6 08	5 59	5 51	5 42	5 31	5 25	5 18
26	6 56	6 47	6 39	6 33	6 27	6 22	6 13	6 06	5 58	5 51	5 43	5 34	5 28	5 22
30	6 46	6 38	6 32	6 26	6 22	6 18	6 10	6 04	5 57	5 51	5 44	5 36	5 31	5 26
Sept. 3	6 36	6 30	6 25	6 20	6 16	6 13	6 07	6 01	5 56	5 51	5 45	5 38	5 34	5 30
7	6 26	6 21	6 17	6 14	6 11	6 08	6 03	5 59	5 55	5 50	5 46	5 40	5 37	5 33
11	6 16	6 13	6 10	6 07	6 05	6 03	6 00	5 56	5 53	5 50	5 47	5 42	5 40	5 37
15	6 06	6 04	6 02	6 01	5 59	5 58	5 56	5 54	5 52	5 50	5 47	5 45	5 43	5 41
19	5 56	5 55	5 55	5 54	5 54	5 53	5 52	5 51	5 50	5 49	5 48	5 47	5 46	5 45
23	5 46	5 46	5 47	5 48	5 48	5 48	5 49	5 49	5 49	5 49	5 49	5 49	5 49	5 49
27	5 35	5 38	5 39	5 41	5 42	5 43	5 45	5 46	5 48	5 49	5 50	5 51	5 52	5 52
Oct. 1	5 25	5 29	5 32	5 34	5 36	5 38	5 41	5 44	5 46	5 49	5 51	5 53	5 55	5 56
5	5 15	5 20	5 24	5 28	5 31	5 33	5 38	5 42	5 45	5 48	5 52	5 56	5 58	6 00

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 1	15 42	16 08	16 29	16 45	16 59	17 11	17 32	17 50	18 08	18 25	18 44	19 05	19 18	19 33
5	15 46	16 11	16 31	16 47	17 01	17 13	17 34	17 51	18 08	18 25	18 44	19 05	19 17	19 32
9	15 50	16 15	16 34	16 50	17 03	17 15	17 35	17 52	18 09	18 26	18 43	19 04	19 17	19 31
13	15 55	16 19	16 37	16 53	17 06	17 17	17 36	17 53	18 09	18 26	18 43	19 03	19 15	19 29
17	16 00	16 23	16 41	16 56	17 08	17 19	17 38	17 54	18 10	18 25	18 42	19 02	19 13	19 27
21	16 06	16 28	16 45	16 59	17 11	17 21	17 39	17 55	18 10	18 25	18 41	19 00	19 11	19 24
25	16 12	16 33	16 49	17 02	17 14	17 24	17 41	17 56	18 10	18 24	18 40	18 58	19 08	19 20
29	16 19	16 38	16 53	17 06	17 16	17 26	17 42	17 56	18 10	18 24	18 38	18 55	19 05	19 17
Aug. 2	16 25	16 43	16 58	17 09	17 19	17 28	17 44	17 57	18 10	18 23	18 36	18 52	19 02	19 13
6	16 32	16 49	17 02	17 13	17 22	17 31	17 45	17 57	18 09	18 21	18 34	18 49	18 58	19 08
10	16 39	16 55	17 07	17 17	17 25	17 33	17 46	17 58	18 09	18 20	18 32	18 46	18 54	19 03
14	16 47	17 00	17 11	17 20	17 28	17 35	17 47	17 58	18 08	18 18	18 29	18 42	18 49	18 58
18	16 54	17 06	17 16	17 24	17 31	17 37	17 48	17 58	18 07	18 16	18 26	18 38	18 45	18 52
22	17 01	17 12	17 21	17 28	17 34	17 40	17 49	17 58	18 06	18 14	18 23	18 34	18 40	18 47
26	17 08	17 18	17 25	17 32	17 37	17 42	17 50	17 58	18 05	18 12	18 20	18 29	18 35	18 41
30	17 16	17 24	17 30	17 35	17 40	17 44	17 51	17 58	18 04	18 10	18 17	18 25	18 29	18 35
Sept. 3	17 23	17 29	17 35	17 39	17 43	17 46	17 52	17 57	18 03	18 08	18 13	18 20	18 24	18 28
7	17 30	17 35	17 39	17 43	17 46	17 48	17 53	17 57	18 01	18 05	18 10	18 15	18 18	18 22
11	17 38	17 41	17 44	17 46	17 49	17 50	17 54	17 57	18 00	18 03	18 06	18 10	18 13	18 15
15	17 45	17 47	17 49	17 50	17 51	17 53	17 55	17 56	17 58	18 00	18 03	18 05	18 07	18 09
19	17 53	17 53	17 54	17 54	17 54	17 55	17 55	17 56	17 57	17 58	17 59	18 00	18 01	18 02
23	18 00	17 59	17 58	17 58	17 57	17 57	17 56	17 56	17 56	17 55	17 55	17 55	17 55	17 55
27	18 08	18 05	18 03	18 02	18 00	17 59	17 57	17 56	17 54	17 53	17 52	17 50	17 50	17 49
Oct. 1	18 15	18 11	18 08	18 06	18 03	18 01	17 58	17 55	17 53	17 50	17 48	17 45	17 44	17 42
5	18 23	18 18	18 13	18 10	18 06	18 04	17 59	17 55	17 52	17 48	17 45	17 41	17 38	17 36

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 1	4 35	4 28	4 21	4 13	4 05	3 55	3 44	3 32	3 18	3 02	2 42	2 17	1 41	0 21
5	4 37	4 31	4 23	4 16	4 07	3 58	3 48	3 36	3 22	3 06	2 47	2 23	1 50	0 48
9	4 40	4 33	4 26	4 19	4 11	4 01	3 51	3 40	3 27	3 12	2 53	2 30	1 59	1 09
13	4 42	4 36	4 29	4 22	4 14	4 05	3 56	3 45	3 32	3 18	3 00	2 39	2 10	1 27
17	4 45	4 39	4 33	4 26	4 18	4 10	4 01	3 50	3 38	3 24	3 08	2 48	2 22	1 45
21	4 49	4 43	4 37	4 30	4 23	4 15	4 06	3 56	3 45	3 31	3 16	2 57	2 34	2 02
25	4 52	4 47	4 41	4 34	4 27	4 20	4 11	4 02	3 51	3 39	3 25	3 08	2 46	2 18
29	4 56	4 51	4 45	4 39	4 32	4 25	4 17	4 09	3 59	3 47	3 34	3 18	2 59	2 34
Aug. 2	4 59	4 55	4 49	4 44	4 38	4 31	4 23	4 15	4 06	3 55	3 43	3 29	3 12	2 50
6	5 03	4 59	4 54	4 48	4 43	4 37	4 30	4 22	4 14	4 04	3 53	3 40	3 24	3 05
10	5 07	5 03	4 58	4 53	4 48	4 42	4 36	4 29	4 21	4 13	4 02	3 51	3 37	3 20
14	5 11	5 07	5 03	4 58	4 54	4 48	4 43	4 36	4 29	4 21	4 12	4 02	3 49	3 34
18	5 14	5 11	5 07	5 03	4 59	4 54	4 49	4 43	4 37	4 30	4 22	4 12	4 01	3 48
22	5 18	5 15	5 12	5 08	5 04	5 00	4 56	4 50	4 45	4 39	4 31	4 23	4 14	4 02
26	5 22	5 19	5 16	5 13	5 10	5 06	5 02	4 58	4 53	4 47	4 41	4 34	4 25	4 16
30	5 26	5 24	5 21	5 18	5 15	5 12	5 09	5 05	5 01	4 56	4 50	4 44	4 37	4 29
Sept. 3	5 30	5 28	5 26	5 23	5 21	5 18	5 15	5 12	5 08	5 04	5 00	4 55	4 49	4 42
7	5 33	5 32	5 30	5 28	5 26	5 24	5 22	5 19	5 16	5 13	5 09	5 05	5 00	4 55
11	5 37	5 36	5 35	5 33	5 32	5 30	5 28	5 26	5 24	5 21	5 19	5 16	5 12	5 08
15	5 41	5 40	5 39	5 38	5 37	5 36	5 35	5 33	5 32	5 30	5 28	5 26	5 23	5 20
19	5 45	5 44	5 44	5 43	5 43	5 42	5 41	5 40	5 40	5 39	5 37	5 36	5 35	5 33
23	5 49	5 48	5 48	5 48	5 48	5 48	5 48	5 48	5 47	5 47	5 47	5 46	5 46	5 46
27	5 52	5 53	5 53	5 53	5 54	5 54	5 54	5 55	5 55	5 56	5 56	5 57	5 57	5 58
Oct. 1	5 56	5 57	5 58	5 58	5 59	6 00	6 01	6 02	6 03	6 04	6 06	6 07	6 09	6 11
5	6 00	6 01	6 02	6 04	6 05	6 06	6 08	6 09	6 11	6 13	6 15	6 18	6 21	6 24

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 1	19 33	19 39	19 47	19 54	20 03	20 12	20 23	20 35	20 49	21 05	21 25	21 50	22 25	23 39
5	19 32	19 38	19 46	19 53	20 02	20 11	20 21	20 33	20 46	21 02	21 21	21 45	22 18	23 16
9	19 31	19 37	19 44	19 51	20 00	20 09	20 19	20 30	20 43	20 58	21 16	21 39	22 09	22 58
13	19 29	19 35	19 42	19 49	19 57	20 05	20 15	20 26	20 38	20 53	21 10	21 31	21 59	22 41
17	19 27	19 32	19 39	19 46	19 53	20 02	20 11	20 21	20 33	20 47	21 03	21 23	21 48	22 24
21	19 24	19 29	19 36	19 42	19 49	19 57	20 06	20 16	20 27	20 40	20 55	21 14	21 37	22 08
25	19 20	19 26	19 32	19 38	19 45	19 52	20 01	20 10	20 20	20 33	20 47	21 03	21 24	21 51
29	19 17	19 22	19 27	19 33	19 40	19 47	19 55	20 03	20 13	20 24	20 37	20 53	21 12	21 35
Aug. 2	19 13	19 17	19 22	19 28	19 34	19 41	19 48	19 56	20 05	20 16	20 27	20 42	20 58	21 20
6	19 08	19 12	19 17	19 22	19 28	19 34	19 41	19 48	19 57	20 06	20 17	20 30	20 45	21 04
10	19 03	19 07	19 12	19 16	19 22	19 27	19 33	19 40	19 48	19 57	20 06	20 18	20 32	20 48
14	18 58	19 02	19 06	19 10	19 15	19 20	19 26	19 32	19 39	19 47	19 55	20 06	20 18	20 32
18	18 52	18 56	18 59	19 03	19 08	19 12	19 17	19 23	19 29	19 36	19 44	19 53	20 04	20 17
22	18 47	18 50	18 53	18 57	19 00	19 04	19 09	19 14	19 19	19 26	19 33	19 41	19 50	20 01
26	18 41	18 43	18 46	18 49	18 53	18 56	19 00	19 05	19 09	19 15	19 21	19 28	19 36	19 45
30	18 35	18 37	18 39	18 42	18 45	18 48	18 51	18 55	18 59	19 04	19 09	19 15	19 22	19 30
Sept. 3	18 28	18 30	18 32	18 34	18 37	18 39	18 42	18 45	18 49	18 53	18 57	19 02	19 08	19 14
7	18 22	18 23	18 25	18 27	18 29	18 31	18 33	18 36	18 38	18 42	18 45	18 49	18 54	18 59
11	18 15	18 16	18 18	18 19	18 21	18 22	18 24	18 26	18 28	18 30	18 33	18 36	18 39	18 43
15	18 09	18 09	18 10	18 11	18 12	18 13	18 15	18 16	18 17	18 19	18 21	18 23	18 25	18 28
19	18 02	18 02	18 03	18 03	18 04	18 05	18 05	18 06	18 07	18 08	18 09	18 10	18 11	18 13
23	17 55	17 55	17 55	17 56	17 56	17 56	17 56	17 56	17 56	17 56	17 56	17 57	17 57	17 57
27	17 49	17 48	17 48	17 48	17 47	17 47	17 46	17 46	17 45	17 45	17 44	17 44	17 43	17 42
Oct. 1	17 42	17 42	17 41	17 40	17 39	17 38	17 37	17 36	17 35	17 34	17 32	17 31	17 29	17 27
5	17 36	17 35	17 34	17 32	17 31	17 30	17 28	17 26	17 24	17 22	17 20	17 18	17 15	17 11

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	5 25	5 29	5 32	5 34	5 36	5 38	5 41	5 44	5 46	5 49	5 51	5 53	5 55	5 56
5	5 15	5 20	5 24	5 28	5 31	5 33	5 38	5 42	5 45	5 48	5 52	5 56	5 58	6 00
9	5 05	5 12	5 17	5 21	5 25	5 29	5 34	5 39	5 44	5 48	5 53	5 58	6 01	6 04
13	4 55	5 03	5 10	5 15	5 20	5 24	5 31	5 37	5 43	5 48	5 54	6 01	6 04	6 08
17	4 45	4 55	5 03	5 09	5 15	5 20	5 28	5 35	5 42	5 49	5 55	6 03	6 08	6 13
21	4 36	4 47	4 56	5 03	5 10	5 16	5 25	5 34	5 41	5 49	5 57	6 06	6 11	6 17
25	4 26	4 39	4 49	4 58	5 05	5 12	5 22	5 32	5 41	5 49	5 58	6 09	6 15	6 21
29	4 17	4 32	4 43	4 53	5 01	5 08	5 20	5 31	5 40	5 50	6 00	6 12	6 18	6 26
Nov. 2	4 08	4 25	4 37	4 48	4 57	5 04	5 18	5 29	5 40	5 51	6 02	6 15	6 22	6 30
6	4 00	4 18	4 32	4 43	4 53	5 01	5 16	5 28	5 40	5 52	6 04	6 18	6 26	6 35
10	3 52	4 12	4 27	4 39	4 50	4 59	5 14	5 28	5 40	5 53	6 06	6 21	6 30	6 39
14	3 45	4 06	4 22	4 35	4 47	4 56	5 13	5 27	5 41	5 54	6 08	6 24	6 34	6 44
18	3 38	4 01	4 18	4 32	4 44	4 54	5 12	5 27	5 42	5 56	6 11	6 28	6 37	6 49
22	3 32	3 56	4 15	4 29	4 42	4 53	5 12	5 28	5 43	5 57	6 13	6 31	6 41	6 53
26	3 27	3 52	4 12	4 27	4 40	4 52	5 11	5 28	5 44	5 59	6 16	6 34	6 45	6 57
30	3 23	3 49	4 09	4 26	4 39	4 51	5 12	5 29	5 45	6 01	6 18	6 37	6 49	7 02
Dec. 4	3 19	3 47	4 08	4 25	4 39	4 51	5 12	5 30	5 47	6 03	6 21	6 41	6 52	7 06
8	3 17	3 46	4 07	4 24	4 39	4 52	5 13	5 31	5 48	6 05	6 23	6 44	6 56	7 09
12	3 16	3 45	4 07	4 25	4 40	4 52	5 14	5 33	5 50	6 07	6 25	6 46	6 59	7 13
16	3 15	3 45	4 08	4 26	4 41	4 54	5 16	5 34	5 52	6 09	6 28	6 49	7 01	7 15
20	3 16	3 47	4 09	4 27	4 42	4 55	5 17	5 36	5 54	6 11	6 30	6 51	7 04	7 18
24	3 19	3 49	4 11	4 29	4 44	4 57	5 19	5 38	5 56	6 13	6 32	6 53	7 06	7 20
28	3 22	3 52	4 14	4 32	4 47	5 00	5 22	5 40	5 58	6 15	6 34	6 55	7 07	7 21
32	3 26	3 55	4 17	4 35	4 50	5 02	5 24	5 43	6 00	6 17	6 35	6 56	7 08	7 22
36	3 31	4 00	4 21	4 38	4 53	5 05	5 27	5 45	6 02	6 18	6 36	6 57	7 09	7 22

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	18 15	18 11	18 08	18 06	18 03	18 01	17 58	17 55	17 53	17 50	17 48	17 45	17 44	17 42
5	18 23	18 18	18 13	18 10	18 06	18 04	17 59	17 55	17 52	17 48	17 45	17 41	17 38	17 36
9	18 31	18 24	18 18	18 14	18 10	18 06	18 00	17 55	17 50	17 46	17 41	17 36	17 33	17 30
13	18 39	18 30	18 23	18 18	18 13	18 09	18 02	17 55	17 49	17 44	17 38	17 31	17 28	17 23
17	18 47	18 37	18 29	18 22	18 16	18 11	18 03	17 55	17 49	17 42	17 35	17 27	17 22	17 17
21	18 55	18 43	18 34	18 26	18 20	18 14	18 04	17 56	17 48	17 40	17 32	17 23	17 18	17 12
25	19 03	18 50	18 40	18 31	18 24	18 17	18 06	17 56	17 47	17 39	17 29	17 19	17 13	17 06
29	19 12	18 57	18 45	18 35	18 27	18 20	18 08	17 57	17 47	17 37	17 27	17 15	17 09	17 01
Nov. 2	19 20	19 04	18 51	18 40	18 31	18 23	18 10	17 58	17 47	17 36	17 25	17 12	17 05	16 56
6	19 28	19 10	18 56	18 45	18 35	18 26	18 12	17 59	17 47	17 35	17 23	17 09	17 01	16 52
10	19 37	19 17	19 02	18 49	18 39	18 30	18 14	18 00	17 47	17 35	17 22	17 07	16 58	16 48
14	19 45	19 24	19 08	18 54	18 43	18 33	18 16	18 02	17 48	17 35	17 20	17 04	16 55	16 44
18	19 53	19 31	19 13	18 59	18 47	18 36	18 19	18 03	17 49	17 35	17 20	17 03	16 53	16 41
22	20 01	19 37	19 19	19 03	18 51	18 40	18 21	18 05	17 50	17 35	17 19	17 01	16 51	16 39
26	20 09	19 43	19 24	19 08	18 55	18 43	18 24	18 07	17 51	17 36	17 19	17 00	16 49	16 37
30	20 16	19 49	19 29	19 12	18 58	18 46	18 26	18 09	17 52	17 36	17 19	17 00	16 48	16 36
Dec. 4	20 22	19 54	19 33	19 16	19 02	18 50	18 29	18 11	17 54	17 37	17 20	17 00	16 48	16 35
8	20 28	19 59	19 37	19 20	19 05	18 53	18 31	18 13	17 56	17 39	17 21	17 00	16 48	16 35
12	20 32	20 03	19 41	19 23	19 08	18 55	18 34	18 15	17 58	17 40	17 22	17 01	16 49	16 35
16	20 36	20 06	19 44	19 26	19 11	18 58	18 36	18 17	17 59	17 42	17 24	17 02	16 50	16 36
20	20 39	20 09	19 46	19 28	19 13	19 00	18 38	18 19	18 01	17 44	17 25	17 04	16 52	16 38
24	20 41	20 11	19 48	19 30	19 15	19 02	18 40	18 21	18 03	17 46	17 27	17 06	16 54	16 40
28	20 41	20 12	19 49	19 31	19 16	19 04	18 42	18 23	18 05	17 48	17 30	17 09	16 56	16 42
32	20 41	20 12	19 50	19 32	19 17	19 05	18 43	18 25	18 07	17 50	17 32	17 11	16 59	16 45
36	20 39	20 11	19 49	19 32	19 18	19 05	18 44	18 26	18 09	17 52	17 35	17 14	17 02	16 49

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	5 56	5 57	5 58	5 58	5 59	6 00	6 01	6 02	6 03	6 04	6 06	6 07	6 09	6 11
5	6 00	6 01	6 02	6 04	6 05	6 06	6 08	6 09	6 11	6 13	6 15	6 18	6 21	6 24
9	6 04	6 06	6 07	6 09	6 11	6 12	6 15	6 17	6 19	6 22	6 25	6 28	6 32	6 37
13	6 08	6 10	6 12	6 14	6 16	6 19	6 21	6 24	6 27	6 31	6 35	6 39	6 44	6 50
17	6 13	6 15	6 17	6 20	6 22	6 25	6 28	6 32	6 36	6 40	6 45	6 50	6 56	7 03
21	6 17	6 19	6 22	6 25	6 28	6 32	6 35	6 39	6 44	6 49	6 55	7 01	7 08	7 17
25	6 21	6 24	6 27	6 31	6 34	6 38	6 43	6 47	6 52	6 58	7 05	7 12	7 21	7 31
29	6 26	6 29	6 33	6 36	6 40	6 45	6 50	6 55	7 01	7 07	7 15	7 23	7 33	7 45
Nov. 2	6 30	6 34	6 38	6 42	6 47	6 51	6 57	7 03	7 09	7 17	7 25	7 35	7 46	7 59
6	6 35	6 39	6 43	6 48	6 53	6 58	7 04	7 11	7 18	7 26	7 35	7 46	7 59	8 14
10	6 39	6 44	6 48	6 53	6 59	7 05	7 11	7 18	7 26	7 35	7 46	7 58	8 12	8 29
14	6 44	6 49	6 54	6 59	7 05	7 11	7 18	7 26	7 35	7 44	7 56	8 09	8 25	8 44
18	6 49	6 54	6 59	7 05	7 11	7 18	7 25	7 34	7 43	7 53	8 06	8 20	8 37	8 59
22	6 53	6 58	7 04	7 10	7 17	7 24	7 32	7 41	7 51	8 02	8 15	8 31	8 50	9 14
26	6 57	7 03	7 09	7 15	7 22	7 30	7 38	7 48	7 58	8 10	8 25	8 41	9 02	9 29
30	7 02	7 07	7 14	7 20	7 28	7 36	7 44	7 54	8 05	8 18	8 33	8 51	9 14	9 44
Dec. 4	7 06	7 12	7 18	7 25	7 32	7 41	7 50	8 00	8 12	8 25	8 41	9 00	9 24	9 58
8	7 09	7 15	7 22	7 29	7 37	7 45	7 55	8 05	8 17	8 31	8 48	9 08	9 34	10 10
12	7 13	7 19	7 25	7 33	7 41	7 49	7 59	8 10	8 22	8 37	8 54	9 15	9 42	10 21
16	7 15	7 22	7 29	7 36	7 44	7 53	8 03	8 14	8 26	8 41	8 58	9 20	9 48	10 29
20	7 18	7 24	7 31	7 38	7 47	7 55	8 05	8 16	8 29	8 44	9 01	9 23	9 51	10 34
24	7 20	7 26	7 33	7 40	7 48	7 57	8 07	8 18	8 31	8 46	9 03	9 25	9 53	10 35
28	7 21	7 27	7 34	7 42	7 50	7 58	8 08	8 19	8 32	8 46	9 03	9 25	9 52	10 33
32	7 22	7 28	7 35	7 42	7 50	7 59	8 08	8 19	8 31	8 45	9 02	9 23	9 49	10 28
36	7 22	7 28	7 35	7 42	7 49	7 58	8 07	8 18	8 30	8 43	9 00	9 19	9 45	10 20

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	17 42	17 42	17 41	17 40	17 39	17 38	17 37	17 36	17 35	17 34	17 32	17 31	17 29	17 27
5	17 36	17 35	17 34	17 32	17 31	17 30	17 28	17 26	17 24	17 22	17 20	17 18	17 15	17 11
9	17 30	17 28	17 26	17 25	17 23	17 21	17 19	17 17	17 14	17 11	17 08	17 05	17 01	16 56
13	17 23	17 22	17 20	17 17	17 15	17 13	17 10	17 07	17 04	17 00	16 57	16 52	16 47	16 41
17	17 17	17 15	17 13	17 10	17 08	17 05	17 01	16 58	16 54	16 50	16 45	16 40	16 33	16 26
21	17 12	17 09	17 06	17 03	17 00	16 57	16 53	16 49	16 44	16 39	16 34	16 27	16 20	16 11
25	17 06	17 03	17 00	16 57	16 53	16 49	16 45	16 40	16 35	16 29	16 22	16 15	16 06	15 56
29	17 01	16 58	16 54	16 50	16 46	16 42	16 37	16 32	16 26	16 19	16 12	16 03	15 53	15 41
Nov. 2	16 56	16 53	16 49	16 44	16 40	16 35	16 30	16 24	16 17	16 10	16 01	15 51	15 40	15 27
6	16 52	16 48	16 44	16 39	16 34	16 29	16 23	16 16	16 09	16 00	15 51	15 40	15 28	15 12
10	16 48	16 44	16 39	16 34	16 28	16 23	16 16	16 09	16 01	15 52	15 41	15 29	15 15	14 58
14	16 44	16 40	16 35	16 29	16 23	16 17	16 10	16 02	15 54	15 44	15 32	15 19	15 03	14 44
18	16 41	16 36	16 31	16 25	16 19	16 12	16 05	15 56	15 47	15 36	15 24	15 10	14 52	14 31
22	16 39	16 34	16 28	16 22	16 15	16 08	16 00	15 51	15 41	15 30	15 16	15 01	14 42	14 17
26	16 37	16 31	16 25	16 19	16 12	16 04	15 56	15 47	15 36	15 24	15 10	14 53	14 32	14 05
30	16 36	16 30	16 24	16 17	16 10	16 02	15 53	15 43	15 32	15 19	15 04	14 46	14 23	13 53
Dec. 4	16 35	16 29	16 22	16 15	16 08	16 00	15 50	15 40	15 28	15 15	14 59	14 40	14 16	13 42
8	16 35	16 28	16 22	16 15	16 07	15 58	15 49	15 38	15 26	15 12	14 56	14 36	14 10	13 33
12	16 35	16 29	16 22	16 15	16 07	15 58	15 48	15 37	15 25	15 11	14 54	14 33	14 06	13 26
16	16 36	16 30	16 23	16 15	16 07	15 59	15 49	15 38	15 25	15 10	14 53	14 32	14 04	13 22
20	16 38	16 31	16 24	16 17	16 09	16 00	15 50	15 39	15 26	15 11	14 54	14 32	14 04	13 21
24	16 40	16 33	16 26	16 19	16 11	16 02	15 52	15 41	15 28	15 14	14 56	14 35	14 06	13 24
28	16 42	16 36	16 29	16 22	16 14	16 05	15 55	15 44	15 32	15 17	15 00	14 39	14 11	13 30
32	16 45	16 39	16 33	16 25	16 17	16 09	15 59	15 48	15 36	15 22	15 05	14 45	14 18	13 40
36	16 49	16 43	16 36	16 29	16 22	16 13	16 04	15 53	15 41	15 28	15 11	14 52	14 27	13 51

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.		−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan.	0	5 53	6 11	6 26	6 38	6 49	6 58	7 13	7 27	7 39	7 52	8 06	8 21	8 30	8 40
	1	6 59	7 15	7 27	7 37	7 46	7 54	8 07	8 18	8 29	8 40	8 51	9 04	9 12	9 20
	2	8 10	8 21	8 31	8 38	8 45	8 51	9 01	9 10	9 18	9 26	9 35	9 45	9 51	9 57
	3	9 23	9 30	9 36	9 41	9 45	9 49	9 56	10 01	10 07	10 12	10 18	10 24	10 28	10 32
	4	10 38	10 41	10 43	10 45	10 47	10 48	10 51	10 53	10 56	10 58	11 00	11 03	11 04	11 06
	5	11 55	11 53	11 52	11 51	11 50	11 49	11 47	11 46	11 45	11 44	11 43	11 41	11 41	11 40
	6	13 13	13 07	13 02	12 58	12 54	12 51	12 45	12 40	12 36	12 31	12 27	12 21	12 18	12 15
	7	14 34	14 22	14 13	14 06	14 00	13 54	13 45	13 36	13 29	13 21	13 13	13 04	12 58	12 52
	8	15 54	15 38	15 26	15 16	15 07	14 59	14 46	14 35	14 24	14 14	14 02	13 50	13 42	13 34
	9	17 12	16 52	16 37	16 25	16 14	16 05	15 49	15 35	15 22	15 10	14 56	14 40	14 31	14 21
	10	18 24	18 02	17 45	17 31	17 20	17 09	16 52	16 37	16 22	16 08	15 53	15 36	15 26	15 15
	11	19 25	19 04	18 47	18 33	18 21	18 11	17 53	17 38	17 23	17 09	16 53	16 36	16 26	16 14
	12	20 16	19 56	19 40	19 28	19 17	19 07	18 51	18 36	18 23	18 09	17 55	17 38	17 29	17 18
	13	20 56	20 39	20 26	20 15	20 06	19 58	19 44	19 31	19 20	19 08	18 56	18 41	18 33	18 24
	14	21 28	21 15	21 05	20 57	20 50	20 43	20 32	20 23	20 13	20 04	19 55	19 43	19 37	19 30
	15	21 54	21 46	21 39	21 33	21 28	21 24	21 17	21 10	21 04	20 57	20 51	20 43	20 39	20 34
	16	22 17	22 13	22 09	22 06	22 04	22 02	21 58	21 54	21 51	21 48	21 45	21 41	21 38	21 36
	17	22 38	22 38	22 37	22 37	22 37	22 37	22 37	22 36	22 36	22 36	22 36	22 36	22 36	22 36
	18	22 58	23 02	23 05	23 07	23 09	23 11	23 14	23 17	23 20	23 23	23 26	23 30	23 32	23 34
	19	23 19	23 26	23 32	23 37	23 41	23 45	23 52	23 58	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
	20	23 41	23 52	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 04	0 09	0 15	0 22	0 26	0 31
	21	.. ..	.. ..	0 01	0 08	0 15	0 20	0 30	0 39	0 47	0 55	1 04	1 14	1 20	1 27
	22	0 06	0 20	0 32	0 42	0 50	0 57	1 10	1 21	1 31	1 42	1 53	2 06	2 14	2 22
	23	0 35	0 53	1 07	1 18	1 28	1 37	1 52	2 05	2 17	2 29	2 43	2 58	3 07	3 17
	24	1 10	1 30	1 46	1 59	2 10	2 20	2 36	2 51	3 04	3 18	3 33	3 49	3 59	4 10

MOONSET

		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan.	0	21 40	21 23	21 10	20 59	20 50	20 42	20 28	20 15	20 03	19 51	19 39	19 24	19 16	19 06
	1	22 10	21 57	21 47	21 38	21 30	21 24	21 12	21 02	20 53	20 43	20 33	20 21	20 14	20 06
	2	22 36	22 27	22 20	22 14	22 08	22 04	21 56	21 48	21 41	21 35	21 27	21 19	21 14	21 08
	3	23 00	22 55	22 51	22 48	22 45	22 42	22 38	22 34	22 30	22 26	22 22	22 17	22 15	22 12
	4	23 23	23 22	23 22	23 21	23 21	23 21	23 20	23 20	23 19	23 18	23 18	23 17	23 17	23 16
	5	23 46	23 50	23 53	23 55	23 58	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
	6	.. ..	.. ..	.. ..	.. ..	.. ..	0 00	0 03	0 06	0 09	0 12	0 15	0 18	0 20	0 22
	7	0 11	0 19	0 26	0 31	0 36	0 41	0 48	0 54	1 01	1 07	1 13	1 21	1 25	1 30
	8	0 39	0 52	1 02	1 11	1 18	1 25	1 36	1 46	1 55	2 04	2 14	2 25	2 32	2 39
	9	1 14	1 31	1 44	1 55	2 04	2 13	2 27	2 40	2 52	3 03	3 16	3 30	3 39	3 49
	10	1 56	2 16	2 32	2 45	2 56	3 06	3 23	3 37	3 51	4 04	4 19	4 36	4 45	4 57
	11	2 49	3 11	3 28	3 42	3 53	4 04	4 22	4 37	4 51	5 06	5 21	5 39	5 49	6 01
	12	3 52	4 13	4 30	4 44	4 55	5 05	5 23	5 38	5 52	6 06	6 21	6 38	6 48	6 59
	13	5 03	5 22	5 37	5 49	5 59	6 08	6 24	6 38	6 50	7 03	7 16	7 32	7 40	7 51
	14	6 18	6 33	6 45	6 55	7 04	7 11	7 24	7 35	7 46	7 56	8 07	8 20	8 27	8 35
	15	7 33	7 44	7 53	8 01	8 07	8 12	8 22	8 30	8 38	8 46	8 54	9 03	9 08	9 14
	16	8 47	8 54	8 59	9 04	9 08	9 11	9 17	9 22	9 27	9 31	9 36	9 42	9 45	9 49
	17	9 59	10 01	10 03	10 05	10 06	10 07	10 10	10 11	10 13	10 15	10 16	10 18	10 19	10 21
	18	11 08	11 07	11 05	11 04	11 03	11 02	11 00	10 59	10 58	10 56	10 55	10 53	10 52	10 51
	19	12 16	12 10	12 05	12 01	11 58	11 55	11 50	11 45	11 41	11 37	11 32	11 27	11 24	11 21
	20	13 22	13 12	13 04	12 58	12 52	12 47	12 39	12 31	12 24	12 18	12 10	12 02	11 57	11 51
	21	14 26	14 13	14 02	13 54	13 46	13 39	13 28	13 18	13 08	12 59	12 49	12 38	12 31	12 24
	22	15 29	15 13	14 59	14 49	14 39	14 31	14 17	14 05	13 53	13 42	13 30	13 16	13 08	12 58
	23	16 30	16 10	15 55	15 43	15 32	15 23	15 07	14 53	14 40	14 27	14 13	13 57	13 47	13 37
	24	17 26	17 05	16 49	16 35	16 24	16 14	15 57	15 42	15 28	15 13	14 58	14 41	14 31	14 20

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.		+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan.	0	8 40	8 45	8 49	8 55	9 00	9 07	9 13	9 21	9 29	9 38	9 49	10 02	10 16	10 34
	1	9 20	9 24	9 28	9 32	9 37	9 42	9 48	9 54	10 01	10 08	10 17	10 27	10 39	10 52
	2	9 57	10 00	10 03	10 07	10 10	10 14	10 18	10 23	10 28	10 34	10 40	10 47	10 56	11 05
	3	10 32	10 34	10 36	10 38	10 41	10 43	10 46	10 49	10 52	10 55	10 59	11 04	11 09	11 15
	4	11 06	11 07	11 08	11 09	11 09	11 11	11 12	11 13	11 14	11 16	11 17	11 19	11 21	11 24
	5	11 40	11 39	11 39	11 39	11 38	11 38	11 37	11 37	11 36	11 35	11 35	11 34	11 33	11 32
	6	12 15	12 13	12 12	12 10	12 08	12 06	12 04	12 02	11 59	11 56	11 53	11 49	11 45	11 41
	7	12 52	12 50	12 47	12 44	12 41	12 37	12 33	12 29	12 25	12 20	12 14	12 07	12 00	11 51
	8	13 34	13 30	13 26	13 22	13 18	13 13	13 07	13 01	12 55	12 48	12 39	12 30	12 19	12 06
	9	14 21	14 17	14 12	14 07	14 01	13 55	13 48	13 41	13 32	13 23	13 12	13 00	12 45	12 28
	10	15 15	15 09	15 04	14 58	14 52	14 45	14 37	14 29	14 19	14 08	13 56	13 41	13 24	13 02
	11	16 14	16 09	16 03	15 57	15 51	15 43	15 35	15 27	15 17	15 06	14 53	14 37	14 19	13 56
	12	17 18	17 13	17 08	17 02	16 56	16 49	16 42	16 34	16 24	16 14	16 02	15 48	15 31	15 10
	13	18 24	18 20	18 15	18 10	18 05	17 59	17 53	17 46	17 38	17 30	17 20	17 08	16 54	16 38
	14	19 30	19 26	19 23	19 19	19 15	19 11	19 06	19 01	18 55	18 48	18 41	18 32	18 22	18 10
	15	20 34	20 32	20 29	20 27	20 24	20 21	20 18	20 14	20 10	20 06	20 01	19 56	19 49	19 42
	16	21 36	21 35	21 34	21 32	21 31	21 29	21 28	21 26	21 24	21 22	21 20	21 17	21 14	21 10
	17	22 36	22 36	22 36	22 36	22 36	22 36	22 36	22 36	22 35	22 35	22 35	22 35	22 35	22 35
	18	23 34	23 35	23 36	23 37	23 38	23 40	23 41	23 43	23 45	23 47	23 49	23 52	23 54	23 58
	19	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
	20	0 31	0 33	0 35	0 37	0 40	0 42	0 45	0 49	0 52	0 56	1 01	1 06	1 12	1 19
	21	1 27	1 30	1 33	1 36	1 40	1 44	1 48	1 53	1 59	2 04	2 11	2 19	2 28	2 39
	22	2 22	2 26	2 30	2 34	2 39	2 44	2 50	2 56	3 03	3 11	3 20	3 30	3 43	3 57
	23	3 17	3 21	3 26	3 31	3 37	3 43	3 50	3 57	4 06	4 15	4 26	4 39	4 54	5 13
	24	4 10	4 15	4 21	4 26	4 33	4 40	4 47	4 56	5 05	5 16	5 28	5 43	6 01	6 23

MOONSET

		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan.	0	19 06	19 02	18 57	18 52	18 47	18 41	18 35	18 27	18 19	18 10	18 00	17 48	17 34	17 16
	1	20 06	20 03	19 59	19 55	19 51	19 46	19 41	19 35	19 29	19 22	19 14	19 04	18 53	18 40
	2	21 08	21 06	21 03	21 00	20 57	20 54	20 50	20 46	20 42	20 37	20 31	20 25	20 17	20 09
	3	22 12	22 10	22 09	22 07	22 05	22 04	22 01	21 59	21 57	21 54	21 51	21 48	21 44	21 39
	4	23 16	23 16	23 16	23 15	23 15	23 15	23 15	23 14	23 14	23 13	23 13	23 12	23 12	23 11
	5	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
	6	0 22	0 23	0 24	0 25	0 27	0 28	0 29	0 31	0 33	0 34	0 37	0 39	0 42	0 45
	7	1 30	1 32	1 34	1 37	1 40	1 42	1 46	1 49	1 53	1 57	2 02	2 08	2 14	2 21
	8	2 39	2 42	2 46	2 50	2 54	2 58	3 03	3 08	3 14	3 21	3 29	3 37	3 48	4 00
	9	3 49	3 53	3 57	4 02	4 08	4 13	4 20	4 27	4 35	4 44	4 54	5 06	5 20	5 37
	10	4 57	5 02	5 07	5 13	5 19	5 26	5 33	5 41	5 51	6 01	6 14	6 28	6 45	7 07
	11	6 01	6 06	6 12	6 18	6 24	6 31	6 39	6 48	6 58	7 09	7 22	7 38	7 56	8 19
	12	6 59	7 04	7 10	7 15	7 22	7 29	7 36	7 45	7 54	8 05	8 17	8 31	8 49	9 10
	13	7 51	7 55	8 00	8 05	8 10	8 16	8 23	8 30	8 39	8 48	8 58	9 10	9 25	9 42
	14	8 35	8 39	8 43	8 47	8 51	8 56	9 01	9 07	9 14	9 21	9 29	9 38	9 49	10 02
	15	9 14	9 17	9 20	9 23	9 26	9 29	9 33	9 37	9 42	9 47	9 53	9 59	10 07	10 15
	16	9 49	9 50	9 52	9 54	9 56	9 58	10 00	10 03	10 05	10 08	10 12	10 16	10 20	10 25
	17	10 21	10 21	10 22	10 22	10 23	10 24	10 25	10 25	10 26	10 27	10 29	10 30	10 31	10 33
	18	10 51	10 51	10 50	10 49	10 49	10 48	10 48	10 47	10 46	10 45	10 44	10 43	10 42	10 40
	19	11 21	11 19	11 18	11 16	11 14	11 12	11 10	11 08	11 05	11 03	11 00	10 56	10 52	10 47
	20	11 51	11 49	11 46	11 44	11 41	11 38	11 34	11 30	11 26	11 21	11 16	11 10	11 03	10 55
	21	12 24	12 20	12 17	12 13	12 09	12 05	12 00	11 54	11 49	11 42	11 35	11 26	11 17	11 05
	22	12 58	12 54	12 50	12 45	12 40	12 35	12 29	12 22	12 15	12 07	11 57	11 46	11 34	11 18
	23	13 37	13 32	13 27	13 22	13 16	13 10	13 03	12 55	12 46	12 36	12 25	12 12	11 56	11 37
	24	14 20	14 15	14 09	14 03	13 57	13 50	13 42	13 34	13 24	13 13	13 01	12 46	12 28	12 06

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 23	0 35	0 53	1 07	1 18	1 28	1 37	1 52	2 05	2 17	2 29	2 43	2 58	3 07	3 17
24	1 10	1 30	1 46	1 59	2 10	2 20	2 36	2 51	3 04	3 18	3 33	3 49	3 59	4 10
25	1 53	2 14	2 31	2 44	2 56	3 06	3 23	3 39	3 53	4 07	4 22	4 40	4 50	5 02
26	2 43	3 04	3 21	3 34	3 46	3 56	4 13	4 29	4 43	4 57	5 12	5 29	5 39	5 51
27	3 42	4 01	4 17	4 29	4 40	4 50	5 06	5 20	5 33	5 46	6 00	6 17	6 26	6 37
28	4 47	5 04	5 17	5 28	5 37	5 46	6 00	6 12	6 24	6 35	6 48	7 02	7 10	7 19
29	5 57	6 11	6 21	6 30	6 37	6 44	6 55	7 05	7 14	7 23	7 33	7 44	7 51	7 58
30	7 11	7 20	7 27	7 33	7 38	7 43	7 51	7 57	8 04	8 10	8 17	8 25	8 29	8 34
31	8 27	8 31	8 35	8 38	8 40	8 43	8 47	8 50	8 53	8 57	9 00	9 04	9 06	9 09
Feb. 1	9 44	9 44	9 43	9 43	9 43	9 43	9 43	9 43	9 43	9 43	9 43	9 43	9 43	9 43
2	11 02	10 57	10 53	10 50	10 47	10 44	10 40	10 37	10 33	10 30	10 26	10 22	10 20	10 17
3	12 20	12 11	12 03	11 57	11 51	11 47	11 39	11 31	11 25	11 18	11 11	11 03	10 59	10 54
4	13 39	13 25	13 14	13 05	12 57	12 50	12 38	12 28	12 18	12 09	11 58	11 47	11 40	11 33
5	14 56	14 38	14 23	14 12	14 02	13 53	13 38	13 26	13 14	13 02	12 49	12 34	12 26	12 16
6	16 08	15 47	15 31	15 17	15 06	14 56	14 39	14 25	14 11	13 57	13 43	13 26	13 16	13 05
7	17 12	16 50	16 33	16 19	16 07	15 57	15 39	15 24	15 09	14 55	14 40	14 22	14 12	14 00
8	18 06	17 45	17 29	17 15	17 04	16 54	16 37	16 22	16 08	15 54	15 39	15 22	15 12	15 00
9	18 50	18 31	18 17	18 05	17 55	17 46	17 31	17 17	17 05	16 52	16 39	16 23	16 14	16 04
10	19 25	19 10	18 59	18 49	18 41	18 34	18 21	18 10	17 59	17 49	17 38	17 25	17 18	17 09
11	19 54	19 43	19 35	19 28	19 22	19 17	19 07	18 59	18 51	18 44	18 35	18 26	18 21	18 14
12	20 19	20 12	20 07	20 03	19 59	19 56	19 50	19 45	19 41	19 36	19 31	19 25	19 22	19 18
13	20 41	20 39	20 37	20 35	20 34	20 33	20 31	20 29	20 27	20 26	20 24	20 22	20 21	20 20
14	21 02	21 03	21 05	21 06	21 07	21 08	21 10	21 11	21 13	21 14	21 16	21 18	21 19	21 20
15	21 22	21 28	21 33	21 36	21 40	21 43	21 48	21 53	21 57	22 01	22 06	22 11	22 15	22 18
16	21 44	21 54	22 01	22 08	22 13	22 18	22 26	22 34	22 41	22 48	22 56	23 04	23 09	23 15

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 23	16 30	16 10	15 55	15 43	15 32	15 23	15 07	14 53	14 40	14 27	14 13	13 57	13 47	13 37
24	17 26	17 05	16 49	16 35	16 24	16 14	15 57	15 42	15 28	15 13	14 58	14 41	14 31	14 20
25	18 17	17 56	17 39	17 26	17 14	17 04	16 46	16 31	16 17	16 02	15 47	15 30	15 19	15 08
26	19 02	18 42	18 26	18 13	18 02	17 52	17 35	17 21	17 07	16 53	16 38	16 21	16 11	16 00
27	19 40	19 23	19 09	18 57	18 47	18 38	18 23	18 10	17 57	17 45	17 32	17 16	17 07	16 57
28	20 13	19 59	19 47	19 37	19 29	19 22	19 09	18 58	18 48	18 37	18 26	18 13	18 06	17 57
29	20 41	20 31	20 22	20 15	20 09	20 04	19 54	19 46	19 38	19 30	19 22	19 12	19 06	19 00
30	21 06	21 00	20 55	20 50	20 47	20 43	20 38	20 32	20 28	20 23	20 17	20 11	20 08	20 04
31	21 30	21 28	21 26	21 25	21 23	21 22	21 20	21 19	21 17	21 15	21 14	21 12	21 10	21 09
Feb. 1	21 53	21 55	21 57	21 59	22 00	22 01	22 03	22 05	22 07	22 09	22 10	22 12	22 14	22 15
2	22 17	22 24	22 29	22 34	22 38	22 41	22 47	22 53	22 58	23 03	23 08	23 14	23 18	23 22
3	22 44	22 55	23 04	23 11	23 18	23 23	23 33	23 42	23 50	23 58	.. ..	.. ..	.. ..	.. ..
4	23 15	23 30	23 42	23 52	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 07	0 17	0 22	0 29
5	23 52	.. ..	.. ..	.. ..	0 01	0 09	0 22	0 33	0 44	0 55	1 07	1 20	1 28	1 37
6	.. ..	0 11	0 26	0 38	0 49	0 58	1 14	1 28	1 41	1 54	2 07	2 23	2 33	2 43
7	0 39	1 00	1 17	1 30	1 42	1 52	2 09	2 24	2 39	2 53	3 08	3 25	3 35	3 47
8	1 35	1 57	2 14	2 28	2 40	2 50	3 08	3 23	3 37	3 52	4 07	4 24	4 34	4 46
9	2 41	3 01	3 17	3 30	3 41	3 51	4 07	4 22	4 35	4 49	5 03	5 19	5 28	5 39
10	3 53	4 10	4 24	4 35	4 45	4 53	5 07	5 20	5 31	5 43	5 55	6 09	6 17	6 26
11	5 08	5 21	5 32	5 41	5 48	5 54	6 06	6 16	6 25	6 34	6 43	6 54	7 01	7 08
12	6 23	6 32	6 39	6 45	6 50	6 55	7 02	7 09	7 15	7 21	7 28	7 35	7 40	7 45
13	7 37	7 41	7 45	7 48	7 50	7 53	7 57	8 00	8 03	8 06	8 10	8 14	8 16	8 18
14	8 48	8 49	8 49	8 49	8 49	8 49	8 49	8 49	8 49	8 49	8 49	8 50	8 50	8 50
15	9 58	9 54	9 51	9 48	9 46	9 44	9 40	9 37	9 34	9 31	9 28	9 24	9 22	9 20
16	11 05	10 58	10 51	10 46	10 41	10 37	10 30	10 24	10 18	10 12	10 06	9 59	9 55	9 51

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 23	3 17	3 21	3 26	3 31	3 37	3 43	3 50	3 57	4 06	4 15	4 26	4 39	4 54	5 13
24	4 10	4 15	4 21	4 26	4 33	4 40	4 47	4 56	5 05	5 16	5 28	5 43	6 01	6 23
25	5 02	5 07	5 13	5 19	5 25	5 33	5 41	5 49	5 59	6 11	6 24	6 39	6 58	7 22
26	5 51	5 56	6 02	6 08	6 14	6 21	6 29	6 38	6 47	6 58	7 11	7 26	7 44	8 07
27	6 37	6 41	6 47	6 52	6 58	7 04	7 12	7 19	7 28	7 38	7 50	8 03	8 19	8 38
28	7 19	7 23	7 27	7 32	7 37	7 43	7 49	7 55	8 03	8 11	8 21	8 32	8 45	9 00
29	7 58	8 01	8 05	8 08	8 12	8 17	8 21	8 27	8 32	8 39	8 46	8 54	9 04	9 15
30	8 34	8 37	8 39	8 42	8 44	8 47	8 50	8 54	8 58	9 02	9 07	9 12	9 19	9 26
31	9 09	9 10	9 11	9 13	9 14	9 16	9 17	9 19	9 21	9 23	9 26	9 28	9 32	9 35
Feb. 1	9 43	9 43	9 43	9 43	9 43	9 43	9 43	9 43	9 43	9 43	9 43	9 43	9 43	9 43
2	10 17	10 16	10 15	10 14	10 12	10 11	10 09	10 08	10 06	10 04	10 01	9 59	9 55	9 52
3	10 54	10 51	10 49	10 46	10 44	10 41	10 37	10 34	10 30	10 26	10 21	10 15	10 09	10 02
4	11 33	11 30	11 26	11 22	11 18	11 14	11 09	11 04	10 58	10 51	10 44	10 36	10 26	10 14
5	12 16	12 12	12 08	12 03	11 58	11 52	11 46	11 39	11 31	11 23	11 13	11 02	10 48	10 33
6	13 05	13 01	12 55	12 50	12 44	12 37	12 30	12 22	12 12	12 02	11 50	11 37	11 20	11 00
7	14 00	13 55	13 50	13 44	13 37	13 30	13 22	13 13	13 04	12 52	12 40	12 24	12 06	11 43
8	15 00	14 55	14 50	14 44	14 38	14 31	14 23	14 14	14 05	13 54	13 41	13 27	13 09	12 46
9	16 04	16 00	15 55	15 49	15 44	15 37	15 31	15 23	15 15	15 05	14 54	14 41	14 26	14 07
10	17 09	17 06	17 02	16 57	16 53	16 48	16 42	16 36	16 29	16 21	16 13	16 03	15 51	15 36
11	18 14	18 12	18 09	18 06	18 02	17 59	17 55	17 50	17 45	17 40	17 33	17 26	17 18	17 08
12	19 18	19 16	19 15	19 13	19 11	19 09	19 06	19 03	19 01	18 57	18 54	18 49	18 45	18 39
13	20 20	20 19	20 19	20 18	20 17	20 17	20 16	20 15	20 14	20 13	20 12	20 10	20 09	20 07
14	21 20	21 20	21 21	21 21	21 22	21 23	21 24	21 24	21 25	21 26	21 28	21 29	21 30	21 32
15	22 18	22 20	22 21	22 23	22 25	22 27	22 30	22 32	22 35	22 38	22 41	22 45	22 50	22 55
16	23 15	23 18	23 20	23 23	23 27	23 30	23 34	23 38	23 42	23 48	23 53	.. ..	.. ..	.. ..

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 23	13 37	13 32	13 27	13 22	13 16	13 10	13 03	12 55	12 46	12 36	12 25	12 12	11 56	11 37
24	14 20	14 15	14 09	14 03	13 57	13 50	13 42	13 34	13 24	13 13	13 01	12 46	12 28	12 06
25	15 08	15 02	14 57	14 51	14 44	14 37	14 29	14 20	14 10	13 59	13 46	13 30	13 11	12 47
26	16 00	15 55	15 50	15 44	15 37	15 30	15 23	15 14	15 05	14 54	14 41	14 26	14 08	13 46
27	16 57	16 52	16 48	16 42	16 37	16 30	16 23	16 16	16 07	15 58	15 46	15 33	15 18	14 59
28	17 57	17 53	17 49	17 45	17 40	17 35	17 29	17 23	17 16	17 08	16 59	16 49	16 37	16 22
29	19 00	18 57	18 54	18 51	18 47	18 43	18 39	18 34	18 29	18 23	18 17	18 09	18 01	17 51
30	20 04	20 02	20 00	19 58	19 56	19 54	19 51	19 48	19 45	19 42	19 38	19 33	19 28	19 22
31	21 09	21 08	21 08	21 07	21 06	21 05	21 05	21 04	21 02	21 01	21 00	20 58	20 57	20 55
Feb. 1	22 15	22 15	22 16	22 17	22 17	22 18	22 19	22 20	22 21	22 22	22 23	22 25	22 26	22 28
2	23 22	23 23	23 25	23 27	23 29	23 32	23 34	23 37	23 40	23 44	23 48	23 52	23 57	.. ..
3	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 03
4	0 29	0 32	0 35	0 38	0 42	0 46	0 50	0 55	1 00	1 06	1 13	1 20	1 29	1 39
5	1 37	1 40	1 45	1 49	1 54	1 59	2 05	2 12	2 19	2 27	2 36	2 47	2 59	3 14
6	2 43	2 48	2 53	2 58	3 04	3 11	3 18	3 25	3 34	3 44	3 56	4 09	4 25	4 45
7	3 47	3 52	3 57	4 03	4 10	4 17	4 25	4 33	4 43	4 54	5 07	5 22	5 40	6 03
8	4 46	4 51	4 57	5 03	5 09	5 16	5 24	5 33	5 42	5 53	6 06	6 21	6 39	7 02
9	5 39	5 44	5 49	5 55	6 01	6 07	6 14	6 22	6 31	6 41	6 52	7 05	7 21	7 41
10	6 26	6 30	6 35	6 39	6 44	6 50	6 56	7 02	7 10	7 18	7 27	7 38	7 50	8 05
11	7 08	7 11	7 14	7 18	7 22	7 26	7 30	7 35	7 41	7 47	7 54	8 02	8 11	8 22
12	7 45	7 47	7 49	7 51	7 54	7 57	8 00	8 03	8 07	8 11	8 15	8 20	8 26	8 33
13	8 18	8 19	8 20	8 21	8 23	8 24	8 26	8 27	8 29	8 31	8 33	8 36	8 39	8 42
14	8 50	8 50	8 50	8 50	8 50	8 50	8 50	8 50	8 50	8 50	8 50	8 50	8 50	8 50
15	9 20	9 19	9 18	9 17	9 16	9 14	9 13	9 11	9 10	9 08	9 05	9 03	9 00	8 57
16	9 51	9 49	9 47	9 44	9 42	9 39	9 36	9 33	9 30	9 26	9 22	9 17	9 11	9 05

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Feb. 15	21 22	21 28	21 33	21 36	21 40	21 43	21 48	21 53	21 57	22 01	22 06	22 11	22 15	22 18
16	21 44	21 54	22 01	22 08	22 13	22 18	22 26	22 34	22 41	22 48	22 56	23 04	23 09	23 15
17	22 08	22 21	22 31	22 40	22 48	22 54	23 06	23 16	23 25	23 35	23 45	23 57	.. ..	.. ..
18	22 35	22 52	23 05	23 15	23 24	23 33	23 47	23 59	.. ..	.. ..	.. ..	.. ..	0 04	0 11
19	23 08	23 27	23 42	23 54	.. ..	.. ..	.. ..	.. ..	0 10	0 22	0 34	0 49	0 57	1 06
20	23 47	.. ..	.. ..	.. ..	0 04	0 14	0 30	0 44	0 57	1 10	1 24	1 40	1 49	2 00
21	.. ..	0 07	0 24	0 37	0 48	0 58	1 15	1 30	1 44	1 58	2 13	2 31	2 41	2 52
22	0 33	0 54	1 11	1 25	1 36	1 46	2 04	2 19	2 33	2 47	3 03	3 20	3 30	3 42
23	1 28	1 48	2 04	2 17	2 28	2 38	2 55	3 10	3 23	3 37	3 52	4 08	4 18	4 29
24	2 30	2 48	3 03	3 14	3 24	3 33	3 48	4 01	4 14	4 26	4 39	4 54	5 03	5 13
25	3 39	3 54	4 05	4 15	4 24	4 31	4 43	4 54	5 05	5 15	5 26	5 38	5 46	5 54
26	4 52	5 03	5 12	5 19	5 25	5 30	5 40	5 48	5 56	6 03	6 11	6 21	6 26	6 32
27	6 09	6 15	6 20	6 25	6 28	6 31	6 37	6 42	6 46	6 51	6 56	7 01	7 04	7 08
28	7 28	7 29	7 31	7 32	7 33	7 33	7 35	7 36	7 37	7 38	7 40	7 41	7 42	7 43
Mar. 1	8 48	8 44	8 42	8 40	8 38	8 36	8 33	8 31	8 29	8 26	8 24	8 21	8 20	8 18
2	10 08	10 00	9 53	9 48	9 43	9 39	9 32	9 26	9 21	9 15	9 09	9 03	8 59	8 55
3	11 28	11 15	11 05	10 57	10 50	10 43	10 33	10 23	10 14	10 06	9 56	9 46	9 40	9 33
4	12 46	12 29	12 16	12 05	11 55	11 47	11 33	11 21	11 09	10 58	10 46	10 32	10 25	10 16
5	13 59	13 39	13 23	13 10	12 59	12 50	12 33	12 19	12 06	11 53	11 39	11 23	11 13	11 03
6	15 05	14 43	14 26	14 12	14 01	13 50	13 33	13 17	13 03	12 49	12 34	12 16	12 06	11 55
7	16 01	15 39	15 23	15 09	14 57	14 47	14 30	14 15	14 00	13 46	13 31	13 14	13 03	12 52
8	16 47	16 27	16 12	16 00	15 49	15 40	15 24	15 10	14 56	14 43	14 29	14 13	14 04	13 53
9	17 24	17 08	16 55	16 45	16 36	16 28	16 14	16 02	15 51	15 39	15 27	15 13	15 05	14 56
10	17 55	17 42	17 33	17 25	17 18	17 11	17 01	16 51	16 42	16 34	16 24	16 13	16 07	16 00
11	18 20	18 12	18 06	18 00	17 56	17 52	17 44	17 38	17 32	17 26	17 19	17 12	17 08	17 03

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Feb. 15	9 58	9 54	9 51	9 48	9 46	9 44	9 40	9 37	9 34	9 31	9 28	9 24	9 22	9 20
16	11 05	10 58	10 51	10 46	10 41	10 37	10 30	10 24	10 18	10 12	10 06	9 59	9 55	9 51
17	12 11	12 00	11 50	11 42	11 36	11 30	11 19	11 11	11 02	10 54	10 45	10 35	10 29	10 23
18	13 15	13 00	12 48	12 38	12 29	12 22	12 09	11 57	11 47	11 36	11 25	11 12	11 05	10 56
19	14 17	13 59	13 44	13 32	13 22	13 13	12 58	12 45	12 33	12 20	12 07	11 52	11 43	11 33
20	15 15	14 54	14 38	14 25	14 14	14 04	13 48	13 33	13 19	13 06	12 51	12 35	12 25	12 14
21	16 08	15 47	15 30	15 16	15 05	14 55	14 37	14 22	14 08	13 53	13 38	13 21	13 11	12 59
22	16 55	16 34	16 18	16 05	15 53	15 43	15 26	15 11	14 57	14 43	14 28	14 11	14 01	13 49
23	17 36	17 17	17 02	16 50	16 40	16 30	16 14	16 01	15 47	15 34	15 20	15 04	14 55	14 44
24	18 11	17 56	17 43	17 32	17 23	17 15	17 02	16 50	16 38	16 27	16 15	16 00	15 52	15 43
25	18 42	18 30	18 20	18 12	18 05	17 58	17 48	17 38	17 29	17 20	17 10	16 59	16 53	16 45
26	19 09	19 01	18 54	18 49	18 44	18 40	18 32	18 26	18 20	18 14	18 07	17 59	17 55	17 50
27	19 33	19 30	19 27	19 24	19 22	19 20	19 16	19 13	19 11	19 08	19 04	19 01	18 59	18 56
28	19 57	19 58	19 58	19 59	19 59	20 00	20 00	20 01	20 02	20 02	20 03	20 03	20 03	20 04
Mar. 1	20 21	20 27	20 31	20 35	20 38	20 40	20 45	20 49	20 53	20 57	21 01	21 06	21 09	21 12
2	20 48	20 57	21 05	21 12	21 18	21 23	21 31	21 39	21 46	21 53	22 01	22 10	22 15	22 21
3	21 18	21 32	21 43	21 52	22 00	22 07	22 20	22 30	22 40	22 51	23 01	23 14	23 21	23 29
4	21 53	22 11	22 25	22 37	22 47	22 55	23 11	23 24	23 36	23 49	.. ..	.. ..	.. ..	.. ..
5	22 36	22 57	23 13	23 26	23 38	23 47	.. ..	.. ..	.. ..	.. ..	0 02	0 17	0 26	0 36
6	23 28	23 50	.. ..	.. ..	.. ..	.. ..	0 04	0 19	0 33	0 47	1 02	1 19	1 29	1 40
7	.. ..	.. ..	0 07	0 21	0 33	0 43	1 01	1 16	1 31	1 45	2 00	2 18	2 28	2 40
8	0 30	0 50	1 07	1 20	1 32	1 42	1 59	2 13	2 27	2 41	2 56	3 13	3 22	3 33
9	1 38	1 56	2 11	2 23	2 33	2 42	2 57	3 10	3 23	3 35	3 48	4 03	4 12	4 21
10	2 50	3 05	3 17	3 26	3 35	3 42	3 55	4 05	4 16	4 26	4 37	4 49	4 56	5 04
11	4 04	4 14	4 23	4 30	4 36	4 42	4 51	4 59	5 06	5 14	5 22	5 31	5 36	5 42

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Feb. 15	22 18	22 20	22 21	22 23	22 25	22 27	22 30	22 32	22 35	22 38	22 41	22 45	22 50	22 55
16	23 15	23 18	23 20	23 23	23 27	23 30	23 34	23 38	23 42	23 48	23 53	.. ..	.. ..	.. ..
17	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 00	0 08	0 17
18	0 11	0 15	0 18	0 22	0 27	0 31	0 36	0 42	0 48	0 55	1 03	1 13	1 23	1 36
19	1 06	1 11	1 15	1 20	1 25	1 31	1 37	1 44	1 52	2 01	2 11	2 23	2 36	2 53
20	2 00	2 05	2 10	2 16	2 22	2 28	2 35	2 44	2 53	3 03	3 15	3 28	3 45	4 06
21	2 52	2 57	3 03	3 09	3 15	3 22	3 30	3 39	3 49	4 00	4 13	4 28	4 46	5 09
22	3 42	3 47	3 53	3 59	4 05	4 13	4 21	4 29	4 39	4 50	5 03	5 19	5 37	6 01
23	4 29	4 34	4 39	4 45	4 51	4 58	5 06	5 14	5 23	5 34	5 46	6 00	6 17	6 38
24	5 13	5 17	5 22	5 27	5 33	5 39	5 45	5 52	6 01	6 10	6 20	6 32	6 46	7 03
25	5 54	5 57	6 01	6 05	6 10	6 15	6 20	6 26	6 32	6 40	6 48	6 57	7 08	7 21
26	6 32	6 35	6 37	6 40	6 44	6 47	6 51	6 55	7 00	7 05	7 11	7 18	7 25	7 34
27	7 08	7 10	7 11	7 13	7 15	7 17	7 19	7 22	7 25	7 28	7 31	7 35	7 39	7 44
28	7 43	7 44	7 44	7 44	7 45	7 46	7 46	7 47	7 48	7 48	7 49	7 50	7 52	7 53
Mar. 1	8 18	8 17	8 17	8 16	8 15	8 14	8 13	8 12	8 11	8 09	8 08	8 06	8 04	8 02
2	8 55	8 53	8 51	8 48	8 46	8 44	8 41	8 38	8 35	8 31	8 27	8 22	8 17	8 11
3	9 33	9 30	9 27	9 24	9 20	9 16	9 12	9 07	9 02	8 56	8 49	8 42	8 33	8 23
4	10 16	10 12	10 07	10 03	9 58	9 53	9 47	9 40	9 33	9 25	9 16	9 06	8 54	8 39
5	11 03	10 58	10 53	10 47	10 42	10 35	10 28	10 20	10 12	10 02	9 51	9 38	9 22	9 03
6	11 55	11 50	11 44	11 38	11 32	11 25	11 17	11 08	10 59	10 48	10 35	10 20	10 03	9 40
7	12 52	12 47	12 41	12 35	12 29	12 22	12 14	12 05	11 55	11 44	11 32	11 16	10 58	10 35
8	13 53	13 48	13 43	13 37	13 31	13 25	13 18	13 10	13 01	12 50	12 39	12 25	12 09	11 48
9	14 56	14 52	14 48	14 43	14 38	14 32	14 26	14 19	14 12	14 03	13 54	13 42	13 29	13 13
10	16 00	15 57	15 53	15 50	15 46	15 41	15 37	15 32	15 26	15 19	15 12	15 04	14 54	14 43
11	17 03	17 01	16 59	16 56	16 54	16 51	16 48	16 44	16 40	16 36	16 32	16 26	16 20	16 13

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Feb. 15	9 20	9 19	9 18	9 17	9 16	9 14	9 13	9 11	9 10	9 08	9 05	9 03	9 00	8 57
16	9 51	9 49	9 47	9 44	9 42	9 39	9 36	9 33	9 30	9 26	9 22	9 17	9 11	9 05
17	10 23	10 20	10 16	10 13	10 10	10 06	10 01	9 57	9 52	9 46	9 39	9 32	9 24	9 14
18	10 56	10 53	10 49	10 44	10 40	10 35	10 29	10 23	10 16	10 09	10 00	9 50	9 39	9 26
19	11 33	11 29	11 24	11 19	11 13	11 07	11 01	10 53	10 45	10 36	10 26	10 13	9 59	9 42
20	12 14	12 09	12 04	11 58	11 52	11 45	11 37	11 29	11 20	11 09	10 57	10 43	10 26	10 06
21	12 59	12 54	12 48	12 42	12 36	12 28	12 21	12 12	12 02	11 51	11 38	11 23	11 04	10 41
22	13 49	13 44	13 38	13 32	13 26	13 19	13 11	13 02	12 52	12 41	12 28	12 13	11 55	11 31
23	14 44	14 39	14 34	14 28	14 22	14 16	14 08	14 00	13 51	13 41	13 29	13 15	12 59	12 38
24	15 43	15 39	15 34	15 30	15 24	15 19	15 12	15 06	14 58	14 49	14 39	14 28	14 14	13 57
25	16 45	16 42	16 38	16 35	16 31	16 26	16 21	16 16	16 10	16 03	15 56	15 47	15 37	15 25
26	17 50	17 48	17 45	17 43	17 40	17 37	17 34	17 30	17 26	17 22	17 17	17 11	17 05	16 57
27	18 56	18 55	18 54	18 53	18 52	18 50	18 49	18 47	18 45	18 43	18 41	18 38	18 35	18 31
28	20 04	20 04	20 04	20 04	20 05	20 05	20 05	20 05	20 05	20 06	20 06	20 06	20 07	20 07
Mar. 1	21 12	21 13	21 15	21 16	21 18	21 20	21 22	21 24	21 27	21 29	21 32	21 36	21 40	21 44
2	22 21	22 23	22 26	22 29	22 32	22 36	22 39	22 43	22 48	22 53	22 59	23 05	23 13	23 22
3	23 29	23 33	23 37	23 41	23 45	23 50	23 56	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
4	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 01	0 08	0 16	0 24	0 34	0 45	0 59
5	0 36	0 40	0 45	0 50	0 56	1 02	1 09	1 16	1 25	1 34	1 45	1 58	2 13	2 31
6	1 40	1 45	1 50	1 56	2 03	2 10	2 17	2 26	2 35	2 46	2 58	3 13	3 31	3 53
7	2 40	2 45	2 50	2 56	3 03	3 10	3 18	3 27	3 36	3 48	4 00	4 16	4 34	4 57
8	3 33	3 38	3 44	3 49	3 56	4 02	4 10	4 18	4 27	4 38	4 50	5 04	5 20	5 41
9	4 21	4 26	4 30	4 35	4 41	4 47	4 53	5 00	5 08	5 17	5 27	5 39	5 53	6 09
10	5 04	5 07	5 11	5 15	5 19	5 24	5 29	5 35	5 41	5 48	5 56	6 05	6 16	6 28
11	5 42	5 44	5 47	5 50	5 53	5 56	6 00	6 04	6 08	6 13	6 19	6 25	6 32	6 41

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 9	17 24	17 08	16 55	16 45	16 36	16 28	16 14	16 02	15 51	15 39	15 27	15 13	15 05	14 56
10	17 55	17 42	17 33	17 25	17 18	17 11	17 01	16 51	16 42	16 34	16 24	16 13	16 07	16 00
11	18 20	18 12	18 06	18 00	17 56	17 52	17 44	17 38	17 32	17 26	17 19	17 12	17 08	17 03
12	18 43	18 39	18 36	18 33	18 31	18 29	18 25	18 22	18 19	18 16	18 13	18 10	18 07	18 05
13	19 04	19 05	19 05	19 05	19 05	19 05	19 05	19 05	19 05	19 05	19 05	19 06	19 06	19 06
14	19 25	19 29	19 32	19 35	19 38	19 40	19 43	19 47	19 50	19 53	19 56	20 00	20 03	20 05
15	19 47	19 54	20 01	20 06	20 11	20 15	20 22	20 28	20 34	20 40	20 47	20 54	20 58	21 03
16	20 10	20 21	20 30	20 38	20 45	20 51	21 01	21 10	21 19	21 27	21 37	21 47	21 53	22 00
17	20 35	20 50	21 02	21 12	21 21	21 28	21 41	21 53	22 04	22 15	22 26	22 39	22 47	22 56
18	21 06	21 23	21 38	21 49	22 00	22 08	22 24	22 37	22 50	23 02	23 16	23 31	23 40	23 50
19	21 41	22 01	22 17	22 30	22 41	22 51	23 08	23 23	23 36	23 50	.. ..	.. ..	.. ..	.. ..
20	22 24	22 45	23 02	23 15	23 27	23 37	23 55	.. ..	.. ..	.. ..	0 05	0 22	0 32	0 43
21	23 14	23 35	23 52	.. ..	.. ..	.. ..	.. ..	0 10	0 24	0 39	0 54	1 11	1 22	1 33
22	.. ..	.. ..	.. ..	0 05	0 17	0 27	0 44	0 59	1 13	1 27	1 42	2 00	2 10	2 21
23	0 12	0 32	0 47	1 00	1 10	1 20	1 36	1 50	2 03	2 16	2 30	2 46	2 55	3 06
24	1 18	1 34	1 47	1 58	2 07	2 15	2 29	2 41	2 53	3 04	3 16	3 30	3 38	3 47
25	2 29	2 41	2 52	3 00	3 07	3 14	3 25	3 34	3 43	3 52	4 02	4 13	4 19	4 26
26	3 44	3 52	3 59	4 05	4 10	4 14	4 21	4 28	4 34	4 40	4 47	4 54	4 58	5 03
27	5 03	5 06	5 10	5 12	5 14	5 16	5 20	5 23	5 25	5 28	5 31	5 35	5 36	5 39
28	6 24	6 23	6 22	6 21	6 20	6 20	6 19	6 18	6 17	6 17	6 16	6 15	6 15	6 14
29	7 46	7 40	7 35	7 31	7 28	7 25	7 20	7 15	7 11	7 07	7 02	6 57	6 54	6 51
30	9 10	8 59	8 50	8 43	8 36	8 31	8 21	8 13	8 06	7 58	7 50	7 41	7 36	7 30
31	10 31	10 16	10 03	9 53	9 45	9 37	9 24	9 13	9 02	8 51	8 40	8 28	8 20	8 12
Apr. 1	11 49	11 30	11 14	11 02	10 51	10 42	10 26	10 13	10 00	9 47	9 33	9 18	9 09	8 59
2	12 59	12 37	12 20	12 07	11 55	11 45	11 27	11 12	10 58	10 44	10 29	10 12	10 02	9 50

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 9	1 38	1 56	2 11	2 23	2 33	2 42	2 57	3 10	3 23	3 35	3 48	4 03	4 12	4 21
10	2 50	3 05	3 17	3 26	3 35	3 42	3 55	4 05	4 16	4 26	4 37	4 49	4 56	5 04
11	4 04	4 14	4 23	4 30	4 36	4 42	4 51	4 59	5 06	5 14	5 22	5 31	5 36	5 42
12	5 17	5 24	5 29	5 33	5 37	5 40	5 45	5 50	5 55	5 59	6 04	6 09	6 12	6 16
13	6 29	6 31	6 33	6 34	6 36	6 37	6 38	6 40	6 41	6 43	6 44	6 46	6 47	6 48
14	7 40	7 38	7 36	7 34	7 33	7 32	7 30	7 28	7 27	7 25	7 23	7 21	7 20	7 19
15	8 49	8 43	8 37	8 33	8 30	8 26	8 21	8 16	8 11	8 07	8 02	7 56	7 53	7 49
16	9 56	9 46	9 38	9 31	9 25	9 20	9 11	9 03	8 56	8 48	8 41	8 32	8 27	8 21
17	11 01	10 48	10 36	10 27	10 19	10 12	10 01	9 50	9 40	9 31	9 20	9 08	9 02	8 54
18	12 04	11 47	11 34	11 22	11 13	11 04	10 50	10 37	10 26	10 14	10 01	9 47	9 39	9 29
19	13 04	12 44	12 29	12 16	12 05	11 56	11 39	11 25	11 12	10 59	10 45	10 28	10 19	10 08
20	13 59	13 38	13 21	13 07	12 56	12 46	12 29	12 14	11 59	11 45	11 30	11 13	11 03	10 51
21	14 48	14 27	14 10	13 56	13 45	13 35	13 17	13 02	12 48	12 33	12 18	12 01	11 50	11 39
22	15 31	15 11	14 55	14 42	14 31	14 22	14 05	13 51	13 37	13 23	13 09	12 52	12 42	12 31
23	16 08	15 51	15 37	15 25	15 16	15 07	14 52	14 39	14 27	14 14	14 01	13 46	13 37	13 27
24	16 40	16 26	16 15	16 05	15 57	15 50	15 38	15 27	15 17	15 07	14 56	14 43	14 36	14 27
25	17 08	16 58	16 50	16 43	16 37	16 32	16 23	16 15	16 07	16 00	15 52	15 42	15 37	15 31
26	17 34	17 28	17 23	17 19	17 16	17 13	17 08	17 03	16 58	16 54	16 49	16 44	16 40	16 37
27	17 58	17 57	17 56	17 55	17 54	17 53	17 52	17 51	17 50	17 49	17 48	17 46	17 46	17 45
28	18 22	18 26	18 28	18 31	18 33	18 34	18 37	18 40	18 43	18 45	18 48	18 51	18 52	18 54
29	18 48	18 56	19 03	19 08	19 13	19 17	19 24	19 31	19 37	19 43	19 49	19 56	20 00	20 05
30	19 17	19 30	19 40	19 49	19 56	20 02	20 13	20 23	20 32	20 41	20 51	21 02	21 09	21 16
31	19 52	20 08	20 22	20 33	20 42	20 51	21 05	21 18	21 29	21 41	21 54	22 08	22 17	22 26
Apr. 1	20 33	20 53	21 09	21 22	21 33	21 43	21 59	22 14	22 27	22 41	22 56	23 12	23 22	23 33
2	21 23	21 45	22 02	22 16	22 28	22 38	22 56	23 11	23 26	23 40	23 56	.. ..	.. ..	.. ..

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 9	14 56	14 52	14 48	14 43	14 38	14 32	14 26	14 19	14 12	14 03	13 54	13 42	13 29	13 13
10	16 00	15 57	15 53	15 50	15 46	15 41	15 37	15 32	15 26	15 19	15 12	15 04	14 54	14 43
11	17 03	17 01	16 59	16 56	16 54	16 51	16 48	16 44	16 40	16 36	16 32	16 26	16 20	16 13
12	18 05	18 04	18 03	18 02	18 01	17 59	17 58	17 56	17 54	17 52	17 50	17 47	17 44	17 41
13	19 06	19 06	19 06	19 06	19 06	19 06	19 06	19 06	19 06	19 07	19 07	19 07	19 07	19 07
14	20 05	20 06	20 07	20 09	20 10	20 12	20 13	20 15	20 17	20 19	20 22	20 25	20 28	20 32
15	21 03	21 05	21 08	21 10	21 13	21 16	21 19	21 22	21 26	21 30	21 35	21 41	21 47	21 55
16	22 00	22 03	22 07	22 10	22 14	22 18	22 23	22 28	22 33	22 40	22 47	22 55	23 04	23 16
17	22 56	23 00	23 04	23 09	23 14	23 19	23 25	23 31	23 38	23 47	23 56	.. ..	.. ..	.. ..
18	23 50	23 55	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 07	0 19	0 35
19	.. ..	.. ..	0 00	0 05	0 11	0 17	0 24	0 32	0 41	0 50	1 02	1 15	1 30	1 50
20	0 43	0 48	0 54	0 59	1 06	1 13	1 20	1 29	1 38	1 49	2 02	2 17	2 35	2 57
21	1 33	1 39	1 44	1 50	1 57	2 04	2 12	2 21	2 31	2 42	2 55	3 11	3 30	3 53
22	2 21	2 26	2 32	2 38	2 44	2 51	2 59	3 07	3 17	3 28	3 41	3 56	4 13	4 36
23	3 06	3 10	3 15	3 21	3 27	3 33	3 40	3 48	3 57	4 06	4 18	4 31	4 47	5 06
24	3 47	3 51	3 55	4 00	4 05	4 11	4 16	4 23	4 30	4 39	4 48	4 59	5 11	5 26
25	4 26	4 29	4 33	4 36	4 40	4 44	4 49	4 54	4 59	5 06	5 13	5 21	5 30	5 41
26	5 03	5 05	5 07	5 10	5 12	5 15	5 18	5 21	5 25	5 29	5 34	5 39	5 45	5 52
27	5 39	5 40	5 41	5 42	5 43	5 44	5 46	5 47	5 49	5 51	5 53	5 55	5 58	6 01
28	6 14	6 14	6 14	6 14	6 13	6 13	6 13	6 12	6 12	6 12	6 11	6 11	6 10	6 10
29	6 51	6 50	6 48	6 46	6 45	6 43	6 41	6 39	6 36	6 33	6 30	6 27	6 23	6 19
30	7 30	7 27	7 24	7 21	7 18	7 15	7 11	7 07	7 02	6 57	6 52	6 45	6 38	6 30
31	8 12	8 08	8 04	8 00	7 56	7 51	7 45	7 40	7 33	7 26	7 17	7 08	6 57	6 44
Apr. 1	8 59	8 54	8 49	8 44	8 38	8 32	8 26	8 18	8 10	8 01	7 50	7 38	7 23	7 05
2	9 50	9 45	9 40	9 34	9 27	9 21	9 13	9 04	8 55	8 44	8 32	8 17	8 00	7 38

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 9	4 21	4 26	4 30	4 35	4 41	4 47	4 53	5 00	5 08	5 17	5 27	5 39	5 53	6 09
10	5 04	5 07	5 11	5 15	5 19	5 24	5 29	5 35	5 41	5 48	5 56	6 05	6 16	6 28
11	5 42	5 44	5 47	5 50	5 53	5 56	6 00	6 04	6 08	6 13	6 19	6 25	6 32	6 41
12	6 16	6 17	6 19	6 21	6 23	6 25	6 27	6 29	6 32	6 35	6 38	6 42	6 46	6 50
13	6 48	6 48	6 49	6 49	6 50	6 51	6 51	6 52	6 53	6 54	6 55	6 56	6 57	6 58
14	7 19	7 18	7 18	7 17	7 16	7 16	7 15	7 14	7 13	7 12	7 10	7 09	7 07	7 06
15	7 49	7 48	7 46	7 44	7 42	7 40	7 38	7 36	7 33	7 30	7 26	7 23	7 18	7 13
16	8 21	8 18	8 16	8 13	8 10	8 06	8 03	7 58	7 54	7 49	7 43	7 37	7 30	7 21
17	8 54	8 50	8 47	8 43	8 39	8 34	8 29	8 24	8 17	8 11	8 03	7 54	7 44	7 32
18	9 29	9 25	9 21	9 16	9 11	9 05	8 59	8 52	8 44	8 36	8 26	8 15	8 02	7 46
19	10 08	10 04	9 58	9 53	9 47	9 40	9 33	9 25	9 17	9 06	8 55	8 42	8 26	8 06
20	10 51	10 46	10 41	10 35	10 28	10 21	10 13	10 05	9 55	9 44	9 31	9 16	8 58	8 35
21	11 39	11 33	11 28	11 22	11 15	11 08	11 00	10 51	10 41	10 30	10 17	10 01	9 42	9 19
22	12 31	12 26	12 20	12 14	12 08	12 01	11 54	11 45	11 36	11 25	11 12	10 58	10 40	10 18
23	13 27	13 22	13 18	13 12	13 07	13 01	12 54	12 46	12 38	12 28	12 17	12 05	11 49	11 31
24	14 27	14 23	14 19	14 15	14 11	14 05	14 00	13 54	13 47	13 39	13 30	13 20	13 08	12 54
25	15 31	15 28	15 25	15 22	15 18	15 15	15 11	15 06	15 01	14 56	14 49	14 42	14 34	14 24
26	16 37	16 35	16 33	16 31	16 29	16 27	16 25	16 22	16 19	16 16	16 12	16 08	16 04	15 58
27	17 45	17 44	17 44	17 43	17 43	17 42	17 42	17 41	17 40	17 40	17 39	17 38	17 36	17 35
28	18 54	18 55	18 56	18 57	18 58	18 59	19 00	19 02	19 03	19 05	19 07	19 09	19 11	19 14
29	20 05	20 07	20 09	20 12	20 14	20 17	20 20	20 24	20 27	20 32	20 36	20 42	20 48	20 55
30	21 16	21 19	21 23	21 27	21 31	21 35	21 40	21 45	21 51	21 58	22 05	22 14	22 24	22 36
31	22 26	22 30	22 35	22 40	22 45	22 51	22 57	23 04	23 12	23 21	23 31	23 43	23 57	.. ..
Apr. 1	23 33	23 38	23 43	23 49	23 55	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 14
2	.. ..	.. ..	.. ..	.. ..	.. ..	0 02	0 09	0 18	0 27	0 38	0 50	1 04	1 21	1 43

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 1	11 49	11 30	11 14	11 02	10 51	10 42	10 26	10 13	10 00	9 47	9 33	9 18	9 09	8 59
2	12 59	12 37	12 20	12 07	11 55	11 45	11 27	11 12	10 58	10 44	10 29	10 12	10 02	9 50
3	13 59	13 37	13 20	13 06	12 54	12 44	12 26	12 10	11 56	11 42	11 26	11 09	10 58	10 47
4	14 47	14 27	14 11	13 58	13 47	13 38	13 21	13 06	12 53	12 39	12 24	12 07	11 58	11 47
5	15 27	15 10	14 56	14 45	14 35	14 26	14 12	13 59	13 47	13 35	13 22	13 07	12 59	12 49
6	15 58	15 45	15 34	15 25	15 17	15 11	14 59	14 48	14 39	14 29	14 18	14 06	13 59	13 52
7	16 25	16 15	16 08	16 01	15 56	15 51	15 42	15 35	15 28	15 21	15 13	15 05	15 00	14 54
8	16 48	16 43	16 38	16 34	16 31	16 28	16 23	16 19	16 15	16 11	16 06	16 02	15 59	15 55
9	17 09	17 08	17 06	17 06	17 05	17 04	17 03	17 02	17 01	16 59	16 58	16 57	16 56	16 56
10	17 29	17 32	17 34	17 36	17 37	17 39	17 41	17 43	17 45	17 47	17 49	17 52	17 53	17 55
11	17 50	17 56	18 02	18 06	18 10	18 13	18 19	18 24	18 29	18 34	18 40	18 46	18 49	18 53
12	18 12	18 22	18 30	18 37	18 43	18 49	18 58	19 06	19 14	19 21	19 30	19 39	19 44	19 51
13	18 36	18 50	19 01	19 11	19 19	19 26	19 38	19 48	19 58	20 09	20 19	20 32	20 39	20 47
14	19 05	19 22	19 35	19 46	19 56	20 05	20 19	20 32	20 44	20 56	21 09	21 24	21 33	21 42
15	19 38	19 57	20 13	20 26	20 37	20 46	21 03	21 17	21 30	21 44	21 59	22 15	22 25	22 36
16	20 17	20 39	20 55	21 09	21 21	21 31	21 48	22 03	22 18	22 32	22 47	23 05	23 15	23 27
17	21 04	21 26	21 43	21 56	22 08	22 18	22 36	22 51	23 06	23 20	23 36	23 53	.. ..	.. ..
18	21 58	22 19	22 35	22 48	22 59	23 09	23 26	23 41	23 54	.. ..	.. ..	.. ..	0 04	0 15
19	22 59	23 18	23 32	23 44	23 54	.. ..	.. ..	.. ..	.. ..	0 08	0 23	0 40	0 49	1 00
20	.. ..	.. ..	.. ..	.. ..	.. ..	0 03	0 18	0 31	0 43	0 55	1 09	1 24	1 32	1 42
21	0 07	0 21	0 33	0 43	0 51	0 58	1 11	1 22	1 32	1 43	1 53	2 06	2 13	2 21
22	1 19	1 29	1 38	1 45	1 51	1 57	2 06	2 14	2 22	2 29	2 37	2 47	2 52	2 58
23	2 35	2 41	2 46	2 50	2 54	2 57	3 02	3 07	3 12	3 16	3 21	3 27	3 30	3 33
24	3 54	3 55	3 57	3 58	3 58	3 59	4 00	4 02	4 03	4 04	4 05	4 07	4 07	4 08
25	5 16	5 13	5 10	5 07	5 05	5 04	5 01	4 58	4 55	4 53	4 50	4 48	4 46	4 44

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 1	20 33	20 53	21 09	21 22	21 33	21 43	21 59	22 14	22 27	22 41	22 56	23 12	23 22	23 33
2	21 23	21 45	22 02	22 16	22 28	22 38	22 56	23 11	23 26	23 40	23 56	.. ..	.. ..	.. ..
3	22 22	22 44	23 01	23 14	23 26	23 36	23 54	.. ..	.. ..	.. ..	.. ..	0 13	0 24	0 35
4	23 28	23 48	.. ..	.. ..	.. ..	.. ..	.. ..	0 09	0 23	0 37	0 52	1 10	1 20	1 31
5	.. ..	.. ..	0 03	0 16	0 27	0 36	0 52	1 06	1 19	1 32	1 45	2 01	2 10	2 21
6	0 39	0 55	1 08	1 19	1 28	1 36	1 49	2 01	2 12	2 23	2 34	2 48	2 55	3 04
7	1 51	2 04	2 13	2 21	2 28	2 34	2 45	2 54	3 02	3 11	3 20	3 30	3 36	3 42
8	3 04	3 12	3 18	3 24	3 28	3 32	3 39	3 45	3 51	3 56	4 02	4 09	4 13	4 17
9	4 15	4 19	4 22	4 24	4 27	4 28	4 32	4 34	4 37	4 40	4 42	4 45	4 47	4 49
10	5 26	5 25	5 25	5 24	5 24	5 24	5 23	5 23	5 22	5 22	5 21	5 20	5 20	5 20
11	6 35	6 30	6 26	6 23	6 20	6 18	6 14	6 10	6 06	6 03	5 59	5 55	5 53	5 50
12	7 43	7 34	7 27	7 21	7 16	7 11	7 04	6 57	6 51	6 44	6 38	6 30	6 25	6 21
13	8 49	8 37	8 26	8 18	8 11	8 05	7 54	7 44	7 35	7 26	7 17	7 06	7 00	6 53
14	9 54	9 37	9 25	9 14	9 05	8 57	8 43	8 31	8 20	8 09	7 57	7 44	7 36	7 27
15	10 55	10 36	10 21	10 08	9 58	9 49	9 33	9 19	9 06	8 53	8 40	8 24	8 15	8 05
16	11 52	11 31	11 14	11 01	10 49	10 39	10 22	10 07	9 53	9 39	9 24	9 07	8 57	8 46
17	12 43	12 21	12 04	11 51	11 39	11 28	11 11	10 55	10 41	10 26	10 11	9 53	9 43	9 31
18	13 28	13 07	12 51	12 37	12 26	12 16	11 58	11 43	11 29	11 15	11 00	10 42	10 32	10 21
19	14 07	13 48	13 33	13 21	13 10	13 01	12 45	12 31	12 18	12 05	11 51	11 34	11 25	11 14
20	14 40	14 24	14 11	14 01	13 52	13 44	13 30	13 18	13 07	12 55	12 43	12 29	12 21	12 12
21	15 09	14 56	14 47	14 38	14 31	14 25	14 14	14 05	13 56	13 47	13 37	13 26	13 20	13 12
22	15 34	15 26	15 20	15 14	15 10	15 05	14 58	14 52	14 45	14 39	14 33	14 25	14 21	14 16
23	15 58	15 55	15 52	15 49	15 47	15 45	15 42	15 39	15 36	15 33	15 30	15 26	15 24	15 22
24	16 22	16 23	16 24	16 24	16 25	16 25	16 26	16 27	16 28	16 28	16 29	16 30	16 30	16 30
25	16 47	16 52	16 57	17 01	17 04	17 07	17 12	17 17	17 21	17 25	17 30	17 35	17 38	17 41

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 1	8 59	8 54	8 49	8 44	8 38	8 32	8 26	8 18	8 10	8 01	7 50	7 38	7 23	7 05
2	9 50	9 45	9 40	9 34	9 27	9 21	9 13	9 04	8 55	8 44	8 32	8 17	8 00	7 38
3	10 47	10 41	10 36	10 30	10 23	10 16	10 08	9 59	9 49	9 38	9 25	9 10	8 51	8 28
4	11 47	11 42	11 36	11 31	11 24	11 17	11 10	11 02	10 52	10 42	10 29	10 15	9 58	9 36
5	12 49	12 44	12 40	12 35	12 29	12 23	12 17	12 10	12 01	11 52	11 42	11 30	11 15	10 58
6	13 52	13 48	13 44	13 40	13 36	13 31	13 26	13 20	13 14	13 07	12 59	12 49	12 38	12 25
7	14 54	14 51	14 49	14 46	14 43	14 39	14 36	14 32	14 27	14 22	14 17	14 10	14 03	13 54
8	15 55	15 54	15 52	15 51	15 49	15 47	15 45	15 43	15 40	15 37	15 34	15 31	15 27	15 22
9	16 56	16 55	16 55	16 55	16 54	16 54	16 53	16 53	16 52	16 51	16 51	16 50	16 49	16 48
10	17 55	17 56	17 56	17 57	17 58	17 59	18 00	18 01	18 03	18 04	18 06	18 08	18 10	18 12
11	18 53	18 55	18 57	18 59	19 01	19 04	19 06	19 09	19 12	19 16	19 20	19 24	19 29	19 35
12	19 51	19 53	19 56	20 00	20 03	20 07	20 11	20 15	20 20	20 26	20 32	20 39	20 48	20 58
13	20 47	20 51	20 55	20 59	21 04	21 09	21 14	21 20	21 27	21 34	21 43	21 53	22 04	22 18
14	21 42	21 47	21 52	21 57	22 02	22 08	22 15	22 22	22 30	22 40	22 50	23 03	23 18	23 36
15	22 36	22 41	22 46	22 52	22 58	23 05	23 13	23 21	23 30	23 41	23 53	.. ..	.. ..	.. ..
16	23 27	23 32	23 38	23 44	23 51	23 58	.. ..	.. ..	.. ..	.. ..	.. ..	0 08	0 25	0 47
17	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 06	0 15	0 25	0 36	0 49	1 05	1 24	1 48
18	0 15	0 21	0 26	0 32	0 39	0 46	0 54	1 03	1 13	1 24	1 38	1 53	2 12	2 36
19	1 00	1 05	1 11	1 16	1 23	1 29	1 37	1 45	1 55	2 05	2 17	2 31	2 48	3 10
20	1 42	1 47	1 51	1 56	2 02	2 08	2 14	2 22	2 30	2 39	2 49	3 01	3 15	3 32
21	2 21	2 25	2 29	2 33	2 37	2 42	2 47	2 53	3 00	3 07	3 15	3 25	3 36	3 48
22	2 58	3 01	3 03	3 07	3 10	3 13	3 17	3 21	3 26	3 31	3 37	3 44	3 51	4 00
23	3 33	3 35	3 37	3 38	3 40	3 42	3 45	3 47	3 50	3 53	3 56	4 00	4 04	4 09
24	4 08	4 09	4 09	4 10	4 10	4 11	4 11	4 12	4 13	4 13	4 14	4 15	4 16	4 18
25	4 44	4 43	4 42	4 42	4 41	4 39	4 38	4 37	4 36	4 34	4 33	4 31	4 29	4 26

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 1	23 33	23 38	23 43	23 49	23 55	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 14
2	.. ..	.. ..	.. ..	.. ..	.. ..	0 02	0 09	0 18	0 27	0 38	0 50	1 04	1 21	1 43
3	0 35	0 40	0 46	0 52	0 59	1 06	1 14	1 23	1 33	1 44	1 57	2 12	2 31	2 54
4	1 31	1 36	1 42	1 48	1 54	2 01	2 09	2 17	2 27	2 38	2 50	3 05	3 22	3 44
5	2 21	2 25	2 30	2 35	2 41	2 47	2 54	3 02	3 10	3 20	3 31	3 43	3 58	4 16
6	3 04	3 08	3 12	3 16	3 21	3 26	3 32	3 38	3 45	3 53	4 01	4 11	4 23	4 37
7	3 42	3 45	3 48	3 52	3 55	3 59	4 03	4 08	4 13	4 19	4 25	4 32	4 41	4 50
8	4 17	4 19	4 21	4 23	4 25	4 28	4 30	4 33	4 37	4 40	4 44	4 49	4 54	5 00
9	4 49	4 50	4 51	4 52	4 53	4 54	4 55	4 56	4 58	4 59	5 01	5 03	5 06	5 08
10	5 20	5 19	5 19	5 19	5 19	5 18	5 18	5 18	5 18	5 17	5 17	5 16	5 16	5 15
11	5 50	5 49	5 47	5 46	5 44	5 43	5 41	5 39	5 37	5 35	5 32	5 29	5 26	5 22
12	6 21	6 18	6 16	6 13	6 11	6 08	6 05	6 01	5 57	5 53	5 48	5 43	5 37	5 30
13	6 53	6 50	6 46	6 43	6 39	6 35	6 30	6 25	6 20	6 13	6 06	5 59	5 49	5 39
14	7 27	7 23	7 19	7 14	7 10	7 04	6 58	6 52	6 45	6 37	6 28	6 17	6 05	5 51
15	8 05	8 00	7 55	7 50	7 44	7 38	7 31	7 23	7 15	7 05	6 54	6 41	6 26	6 08
16	8 46	8 41	8 35	8 29	8 23	8 16	8 08	8 00	7 50	7 39	7 27	7 12	6 54	6 32
17	9 31	9 26	9 20	9 14	9 07	9 00	8 52	8 43	8 33	8 21	8 08	7 53	7 33	7 09
18	10 21	10 15	10 10	10 04	9 57	9 50	9 42	9 33	9 23	9 12	8 59	8 44	8 25	8 01
19	11 14	11 09	11 04	10 59	10 53	10 46	10 39	10 31	10 22	10 11	9 59	9 46	9 29	9 08
20	12 12	12 07	12 03	11 58	11 53	11 47	11 41	11 34	11 27	11 18	11 08	10 56	10 43	10 26
21	13 12	13 09	13 05	13 02	12 58	12 53	12 48	12 43	12 37	12 30	12 23	12 14	12 04	11 52
22	14 16	14 14	14 11	14 09	14 06	14 03	14 00	13 56	13 52	13 48	13 43	13 37	13 30	13 23
23	15 22	15 21	15 20	15 19	15 17	15 16	15 14	15 13	15 11	15 09	15 06	15 04	15 01	14 57
24	16 30	16 31	16 31	16 31	16 31	16 32	16 32	16 32	16 33	16 33	16 33	16 34	16 34	16 35
25	17 41	17 43	17 44	17 46	17 48	17 50	17 52	17 54	17 57	18 00	18 03	18 07	18 11	18 16

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 24	3 54	3 55	3 57	3 58	3 58	3 59	4 00	4 02	4 03	4 04	4 05	4 07	4 07	4 08
25	5 16	5 13	5 10	5 07	5 05	5 04	5 01	4 58	4 55	4 53	4 50	4 48	4 46	4 44
26	6 41	6 32	6 25	6 19	6 14	6 10	6 03	5 56	5 50	5 44	5 38	5 31	5 27	5 22
27	8 06	7 52	7 41	7 32	7 25	7 18	7 06	6 56	6 47	6 38	6 28	6 17	6 10	6 03
28	9 29	9 11	8 56	8 45	8 35	8 26	8 11	7 58	7 46	7 34	7 21	7 07	6 58	6 49
29	10 45	10 24	10 08	9 54	9 43	9 33	9 15	9 01	8 47	8 33	8 18	8 01	7 51	7 40
30	11 52	11 30	11 12	10 58	10 46	10 36	10 17	10 02	9 47	9 33	9 17	8 59	8 49	8 37
May 1	12 46	12 25	12 09	11 55	11 43	11 33	11 16	11 00	10 46	10 32	10 17	9 59	9 49	9 38
2	13 30	13 11	12 56	12 44	12 34	12 25	12 09	11 55	11 43	11 30	11 16	11 00	10 51	10 41
3	14 04	13 49	13 37	13 27	13 18	13 11	12 58	12 47	12 36	12 25	12 14	12 01	11 53	11 45
4	14 31	14 21	14 12	14 04	13 58	13 52	13 43	13 34	13 26	13 18	13 10	13 00	12 54	12 48
5	14 55	14 48	14 43	14 38	14 34	14 30	14 24	14 19	14 14	14 09	14 03	13 57	13 53	13 49
6	15 16	15 13	15 11	15 09	15 07	15 06	15 03	15 01	14 59	14 57	14 55	14 52	14 51	14 49
7	15 36	15 37	15 38	15 39	15 40	15 40	15 41	15 42	15 43	15 44	15 45	15 47	15 47	15 48
8	15 56	16 01	16 05	16 09	16 12	16 14	16 19	16 23	16 27	16 31	16 35	16 40	16 43	16 46
9	16 17	16 26	16 33	16 39	16 44	16 49	16 57	17 04	17 11	17 18	17 25	17 33	17 38	17 44
10	16 40	16 52	17 03	17 11	17 18	17 25	17 36	17 46	17 55	18 05	18 15	18 26	18 33	18 40
11	17 06	17 22	17 35	17 46	17 55	18 03	18 17	18 29	18 40	18 52	19 04	19 19	19 27	19 36
12	17 37	17 56	18 11	18 24	18 34	18 43	18 59	19 13	19 27	19 40	19 54	20 10	20 20	20 31
13	18 14	18 35	18 52	19 05	19 17	19 27	19 44	19 59	20 14	20 28	20 43	21 01	21 11	21 23
14	18 58	19 20	19 37	19 51	20 03	20 13	20 31	20 47	21 01	21 16	21 32	21 50	22 00	22 12
15	19 49	20 10	20 27	20 41	20 52	21 03	21 20	21 35	21 50	22 04	22 19	22 37	22 47	22 58
16	20 47	21 07	21 22	21 34	21 45	21 55	22 11	22 25	22 38	22 51	23 05	23 21	23 30	23 41
17	21 51	22 07	22 21	22 31	22 41	22 49	23 02	23 15	23 26	23 37	23 49	.. ..	.. ..	.. ..
18	23 00	23 12	23 22	23 31	23 38	23 44	23 55	.. ..	.. ..	.. ..	.. ..	0 03	0 11	0 20

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 24	16 22	16 23	16 24	16 24	16 25	16 25	16 26	16 27	16 28	16 28	16 29	16 30	16 30	16 30
25	16 47	16 52	16 57	17 01	17 04	17 07	17 12	17 17	17 21	17 25	17 30	17 35	17 38	17 41
26	17 14	17 25	17 33	17 40	17 46	17 52	18 01	18 09	18 17	18 25	18 33	18 42	18 48	18 54
27	17 46	18 01	18 13	18 23	18 32	18 40	18 53	19 04	19 15	19 26	19 37	19 50	19 58	20 07
28	18 25	18 44	18 59	19 12	19 22	19 32	19 48	20 02	20 15	20 28	20 42	20 58	21 07	21 18
29	19 13	19 35	19 52	20 06	20 18	20 28	20 46	21 01	21 15	21 30	21 45	22 03	22 13	22 25
30	20 11	20 33	20 51	21 05	21 17	21 27	21 45	22 01	22 16	22 30	22 46	23 03	23 14	23 26
May 1	21 17	21 38	21 54	22 07	22 18	22 28	22 45	23 00	23 14	23 27	23 42	23 58	.. ..	.. ..
2	22 28	22 46	23 00	23 11	23 21	23 29	23 44	23 57	.. ..	.. ..	.. ..	.. ..	0 08	0 19
3	23 41	23 55	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 09	0 20	0 33	0 47	0 55	1 05
4	.. ..	.. ..	0 06	0 15	0 22	0 29	0 41	0 51	1 00	1 10	1 20	1 31	1 37	1 45
5	0 54	1 03	1 11	1 17	1 23	1 27	1 35	1 43	1 49	1 56	2 03	2 11	2 15	2 20
6	2 06	2 11	2 15	2 18	2 21	2 24	2 28	2 32	2 36	2 39	2 43	2 47	2 50	2 53
7	3 16	3 17	3 17	3 18	3 18	3 19	3 19	3 20	3 21	3 21	3 22	3 22	3 23	3 23
8	4 25	4 21	4 19	4 16	4 14	4 13	4 10	4 07	4 05	4 02	3 59	3 56	3 55	3 53
9	5 33	5 25	5 19	5 14	5 10	5 06	4 59	4 54	4 48	4 43	4 37	4 31	4 27	4 23
10	6 39	6 28	6 19	6 11	6 05	5 59	5 49	5 40	5 32	5 24	5 16	5 06	5 00	4 54
11	7 45	7 29	7 17	7 07	6 59	6 52	6 39	6 27	6 17	6 07	5 55	5 43	5 35	5 27
12	8 47	8 29	8 14	8 03	7 52	7 44	7 28	7 15	7 03	6 50	6 37	6 22	6 13	6 03
13	9 46	9 25	9 09	8 56	8 45	8 35	8 18	8 03	7 49	7 35	7 21	7 04	6 54	6 43
14	10 40	10 18	10 01	9 47	9 35	9 25	9 07	8 51	8 37	8 22	8 07	7 49	7 38	7 26
15	11 27	11 05	10 48	10 35	10 23	10 12	9 55	9 39	9 25	9 10	8 55	8 37	8 26	8 14
16	12 08	11 48	11 32	11 19	11 08	10 58	10 41	10 27	10 13	9 59	9 44	9 27	9 17	9 06
17	12 42	12 25	12 11	12 00	11 50	11 41	11 26	11 13	11 01	10 49	10 35	10 20	10 11	10 01
18	13 12	12 58	12 47	12 37	12 29	12 22	12 10	11 59	11 49	11 39	11 28	11 15	11 08	11 00

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 24	4 08	4 09	4 09	4 10	4 10	4 11	4 11	4 12	4 13	4 13	4 14	4 15	4 16	4 18
25	4 44	4 43	4 42	4 42	4 41	4 39	4 38	4 37	4 36	4 34	4 33	4 31	4 29	4 26
26	5 22	5 20	5 18	5 15	5 13	5 10	5 07	5 04	5 01	4 57	4 52	4 48	4 42	4 36
27	6 03	6 00	5 57	5 53	5 49	5 45	5 40	5 35	5 29	5 23	5 16	5 08	4 59	4 48
28	6 49	6 45	6 40	6 35	6 30	6 24	6 18	6 11	6 04	5 55	5 45	5 34	5 21	5 05
29	7 40	7 35	7 30	7 24	7 18	7 11	7 04	6 56	6 46	6 36	6 24	6 10	5 53	5 33
30	8 37	8 31	8 26	8 20	8 13	8 06	7 58	7 49	7 39	7 27	7 14	6 59	6 40	6 16
May 1	9 38	9 32	9 27	9 21	9 14	9 07	8 59	8 51	8 41	8 30	8 17	8 02	7 43	7 20
2	10 41	10 36	10 31	10 26	10 20	10 14	10 07	9 59	9 50	9 40	9 29	9 16	9 00	8 40
3	11 45	11 41	11 37	11 32	11 27	11 22	11 16	11 10	11 03	10 55	10 46	10 36	10 23	10 09
4	12 48	12 45	12 42	12 38	12 35	12 31	12 27	12 22	12 17	12 11	12 05	11 57	11 49	11 38
5	13 49	13 47	13 45	13 43	13 41	13 39	13 36	13 33	13 30	13 26	13 22	13 18	13 13	13 07
6	14 49	14 49	14 48	14 47	14 46	14 45	14 44	14 43	14 42	14 40	14 39	14 37	14 35	14 33
7	15 48	15 49	15 49	15 49	15 50	15 50	15 51	15 52	15 52	15 53	15 54	15 55	15 56	15 57
8	16 46	16 48	16 49	16 51	16 53	16 55	16 57	16 59	17 01	17 04	17 07	17 11	17 15	17 20
9	17 44	17 46	17 49	17 52	17 55	17 58	18 01	18 05	18 10	18 15	18 20	18 26	18 34	18 42
10	18 40	18 44	18 47	18 51	18 55	19 00	19 05	19 11	19 17	19 24	19 31	19 40	19 51	20 03
11	19 36	19 40	19 45	19 50	19 55	20 01	20 07	20 14	20 22	20 31	20 41	20 52	21 06	21 23
12	20 31	20 35	20 41	20 46	20 52	20 59	21 06	21 14	21 23	21 34	21 46	22 00	22 17	22 38
13	21 23	21 28	21 34	21 40	21 46	21 54	22 02	22 10	22 20	22 32	22 45	23 01	23 20	23 44
14	22 12	22 18	22 23	22 30	22 36	22 44	22 52	23 01	23 11	23 23	23 36	23 52	.. ..	.. ..
15	22 58	23 03	23 09	23 15	23 21	23 29	23 36	23 45	23 55	.. ..	.. ..	.. ..	0 12	0 37
16	23 41	23 45	23 51	23 56	.. ..	.. ..	.. ..	.. ..	.. ..	0 06	0 19	0 34	0 52	1 15
17	.. ..	.. ..	.. ..	.. ..	0 02	0 08	0 15	0 23	0 32	0 42	0 53	1 06	1 22	1 41
18	0 20	0 24	0 28	0 33	0 38	0 43	0 49	0 56	1 03	1 11	1 20	1 31	1 43	1 58

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 24	16 30	16 31	16 31	16 31	16 31	16 32	16 32	16 32	16 33	16 33	16 33	16 34	16 34	16 35
25	17 41	17 43	17 44	17 46	17 48	17 50	17 52	17 54	17 57	18 00	18 03	18 07	18 11	18 16
26	18 54	18 57	18 59	19 03	19 06	19 10	19 14	19 18	19 23	19 29	19 35	19 42	19 50	20 00
27	20 07	20 11	20 15	20 19	20 24	20 29	20 35	20 41	20 49	20 57	21 06	21 16	21 29	21 44
28	21 18	21 23	21 28	21 33	21 39	21 46	21 53	22 01	22 10	22 20	22 32	22 45	23 01	23 22
29	22 25	22 30	22 36	22 42	22 48	22 56	23 04	23 12	23 22	23 34	23 47	.. ..	.. ..	.. ..
30	23 26	23 31	23 36	23 43	23 49	23 56	.. ..	.. ..	.. ..	.. ..	.. ..	0 02	0 21	0 45
May 1	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 04	0 13	0 23	0 34	0 47	1 03	1 21	1 45
2	0 19	0 24	0 29	0 34	0 40	0 47	0 54	1 02	1 11	1 22	1 33	1 47	2 03	2 23
3	1 05	1 09	1 13	1 18	1 23	1 29	1 35	1 42	1 49	1 58	2 07	2 18	2 31	2 47
4	1 45	1 48	1 52	1 55	1 59	2 04	2 08	2 13	2 19	2 26	2 33	2 41	2 51	3 02
5	2 20	2 22	2 25	2 27	2 30	2 33	2 36	2 40	2 44	2 48	2 53	2 59	3 05	3 12
6	2 53	2 54	2 55	2 56	2 58	3 00	3 01	3 03	3 05	3 08	3 10	3 13	3 16	3 20
7	3 23	3 23	3 23	3 24	3 24	3 24	3 24	3 24	3 25	3 25	3 25	3 26	3 26	3 27
8	3 53	3 52	3 51	3 50	3 49	3 48	3 46	3 45	3 44	3 42	3 40	3 38	3 36	3 33
9	4 23	4 21	4 19	4 17	4 14	4 12	4 09	4 06	4 03	3 59	3 55	3 51	3 46	3 40
10	4 54	4 51	4 48	4 45	4 41	4 38	4 33	4 29	4 24	4 18	4 12	4 05	3 57	3 48
11	5 27	5 23	5 19	5 15	5 11	5 06	5 00	4 54	4 48	4 40	4 32	4 22	4 11	3 58
12	6 03	5 59	5 54	5 49	5 43	5 37	5 31	5 23	5 15	5 06	4 56	4 44	4 29	4 12
13	6 43	6 38	6 32	6 27	6 20	6 14	6 06	5 58	5 48	5 38	5 26	5 11	4 54	4 33
14	7 26	7 21	7 15	7 09	7 03	6 55	6 47	6 38	6 28	6 17	6 03	5 48	5 28	5 04
15	8 14	8 09	8 03	7 57	7 50	7 43	7 35	7 26	7 16	7 04	6 51	6 35	6 15	5 50
16	9 06	9 01	8 56	8 50	8 43	8 36	8 29	8 20	8 11	8 00	7 47	7 32	7 14	6 51
17	10 01	9 57	9 52	9 47	9 41	9 35	9 28	9 21	9 12	9 03	8 52	8 39	8 24	8 05
18	11 00	10 56	10 52	10 48	10 43	10 38	10 32	10 26	10 19	10 12	10 03	9 53	9 41	9 27

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
May 17	21 51	22 07	22 21	22 31	22 41	22 49	23 02	23 15	23 26	23 37	23 49	.. ..	.. ..	.. ..
18	23 00	23 12	23 22	23 31	23 38	23 44	23 55	.. ..	.. ..	.. ..	.. ..	0 03	0 11	0 20
19	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 05	0 14	0 23	0 32	0 43	0 49	0 56
20	0 12	0 20	0 27	0 33	0 38	0 42	0 50	0 56	1 02	1 08	1 15	1 22	1 26	1 31
21	1 28	1 32	1 35	1 37	1 40	1 42	1 45	1 48	1 51	1 54	1 57	2 01	2 03	2 05
22	2 47	2 46	2 45	2 44	2 44	2 43	2 43	2 42	2 41	2 41	2 40	2 40	2 39	2 39
23	4 08	4 03	3 58	3 54	3 50	3 47	3 42	3 38	3 34	3 30	3 25	3 20	3 18	3 15
24	5 33	5 22	5 13	5 06	5 00	4 54	4 45	4 37	4 29	4 21	4 13	4 04	3 59	3 53
25	6 58	6 42	6 30	6 19	6 10	6 03	5 49	5 38	5 27	5 16	5 05	4 52	4 45	4 36
26	8 20	8 00	7 45	7 32	7 21	7 11	6 55	6 41	6 28	6 15	6 01	5 45	5 36	5 25
27	9 35	9 13	8 55	8 41	8 29	8 18	8 00	7 45	7 30	7 16	7 00	6 42	6 32	6 20
28	10 38	10 15	9 58	9 44	9 31	9 21	9 03	8 47	8 32	8 18	8 02	7 44	7 33	7 21
29	11 27	11 07	10 51	10 38	10 27	10 17	10 01	9 46	9 32	9 19	9 04	8 47	8 37	8 26
30	12 06	11 49	11 36	11 25	11 16	11 07	10 53	10 41	10 29	10 17	10 05	9 50	9 42	9 32
31	12 37	12 24	12 14	12 06	11 58	11 52	11 41	11 31	11 22	11 13	11 03	10 52	10 45	10 38
June 1	13 02	12 54	12 47	12 41	12 36	12 32	12 24	12 18	12 11	12 05	11 58	11 51	11 46	11 41
2	13 24	13 20	13 16	13 13	13 11	13 08	13 05	13 01	12 58	12 55	12 51	12 47	12 45	12 43
3	13 44	13 44	13 43	13 43	13 43	13 43	13 43	13 43	13 43	13 43	13 43	13 42	13 42	13 42
4	14 03	14 07	14 10	14 13	14 15	14 17	14 20	14 24	14 26	14 29	14 33	14 36	14 38	14 41
5	14 23	14 31	14 37	14 43	14 47	14 51	14 58	15 04	15 10	15 16	15 22	15 29	15 33	15 38
6	14 45	14 57	15 06	15 14	15 20	15 26	15 36	15 45	15 54	16 02	16 11	16 22	16 28	16 35
7	15 10	15 25	15 37	15 47	15 55	16 03	16 16	16 28	16 38	16 49	17 01	17 14	17 22	17 31
8	15 39	15 57	16 11	16 23	16 33	16 42	16 58	17 11	17 24	17 37	17 50	18 06	18 15	18 26
9	16 13	16 34	16 50	17 03	17 15	17 25	17 42	17 57	18 11	18 25	18 40	18 57	19 07	19 19
10	16 55	17 17	17 34	17 48	18 00	18 10	18 28	18 44	18 59	19 13	19 29	19 47	19 58	20 10

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
May 17	12 42	12 25	12 11	12 00	11 50	11 41	11 26	11 13	11 01	10 49	10 35	10 20	10 11	10 01
18	13 12	12 58	12 47	12 37	12 29	12 22	12 10	11 59	11 49	11 39	11 28	11 15	11 08	11 00
19	13 38	13 28	13 19	13 13	13 07	13 02	12 52	12 44	12 37	12 29	12 21	12 12	12 06	12 00
20	14 01	13 55	13 51	13 47	13 43	13 40	13 35	13 30	13 25	13 21	13 16	13 10	13 07	13 03
21	14 24	14 22	14 21	14 20	14 19	14 19	14 17	14 16	14 15	14 14	14 12	14 11	14 10	14 09
22	14 47	14 50	14 53	14 55	14 57	14 58	15 01	15 04	15 06	15 08	15 11	15 14	15 15	15 17
23	15 12	15 20	15 26	15 32	15 36	15 40	15 47	15 54	16 00	16 05	16 12	16 19	16 23	16 28
24	15 41	15 53	16 04	16 12	16 19	16 26	16 37	16 47	16 56	17 05	17 15	17 26	17 33	17 40
25	16 16	16 33	16 47	16 58	17 08	17 16	17 31	17 44	17 56	18 08	18 21	18 35	18 44	18 54
26	16 59	17 20	17 36	17 50	18 01	18 11	18 28	18 43	18 57	19 11	19 26	19 43	19 53	20 05
27	17 54	18 16	18 34	18 48	19 00	19 11	19 29	19 45	20 00	20 15	20 30	20 49	20 59	21 11
28	18 58	19 20	19 37	19 51	20 03	20 14	20 31	20 47	21 01	21 15	21 31	21 48	21 58	22 10
29	20 10	20 30	20 45	20 57	21 08	21 17	21 33	21 47	22 00	22 13	22 26	22 42	22 51	23 01
30	21 25	21 41	21 53	22 03	22 12	22 20	22 33	22 44	22 55	23 05	23 16	23 29	23 36	23 45
31	22 41	22 52	23 01	23 08	23 15	23 20	23 30	23 38	23 46	23 54	.. ..	.. ..	.. ..	.. ..
June 1	23 54	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 02	0 11	0 16	0 22
2	.. ..	0 01	0 06	0 11	0 15	0 18	0 24	0 29	0 34	0 39	0 44	0 49	0 53	0 56
3	1 06	1 08	1 10	1 12	1 13	1 14	1 16	1 18	1 20	1 21	1 23	1 25	1 26	1 27
4	2 15	2 13	2 12	2 11	2 09	2 08	2 07	2 05	2 04	2 02	2 01	1 59	1 58	1 57
5	3 23	3 17	3 12	3 08	3 05	3 02	2 56	2 52	2 47	2 43	2 38	2 33	2 30	2 26
6	4 30	4 20	4 12	4 05	4 00	3 55	3 46	3 38	3 31	3 24	3 16	3 07	3 02	2 57
7	5 36	5 22	5 11	5 02	4 54	4 47	4 35	4 25	4 15	4 05	3 55	3 43	3 37	3 29
8	6 40	6 22	6 09	5 57	5 48	5 39	5 25	5 12	5 00	4 48	4 36	4 21	4 13	4 04
9	7 40	7 20	7 05	6 52	6 41	6 31	6 14	6 00	5 47	5 33	5 19	5 02	4 53	4 42
10	8 36	8 15	7 58	7 44	7 32	7 21	7 04	6 48	6 34	6 19	6 04	5 46	5 36	5 24

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
May 17	.. ..	.. ..	.. ..	.. ..	0 02	0 08	0 15	0 23	0 32	0 42	0 53	1 06	1 22	1 41
18	0 20	0 24	0 28	0 33	0 38	0 43	0 49	0 56	1 03	1 11	1 20	1 31	1 43	1 58
19	0 56	1 00	1 03	1 07	1 10	1 15	1 19	1 24	1 30	1 36	1 43	1 51	2 00	2 11
20	1 31	1 33	1 35	1 38	1 40	1 43	1 46	1 50	1 53	1 57	2 02	2 07	2 13	2 20
21	2 05	2 06	2 07	2 08	2 09	2 11	2 12	2 14	2 15	2 17	2 19	2 22	2 25	2 28
22	2 39	2 39	2 39	2 38	2 38	2 38	2 38	2 37	2 37	2 37	2 37	2 36	2 36	2 35
23	3 15	3 13	3 12	3 10	3 08	3 07	3 05	3 03	3 00	2 58	2 55	2 51	2 48	2 43
24	3 53	3 51	3 48	3 45	3 42	3 38	3 35	3 30	3 26	3 21	3 15	3 09	3 02	2 53
25	4 36	4 33	4 29	4 24	4 20	4 15	4 09	4 03	3 57	3 49	3 41	3 31	3 20	3 07
26	5 25	5 20	5 15	5 10	5 04	4 58	4 51	4 43	4 35	4 25	4 14	4 02	3 46	3 28
27	6 20	6 15	6 09	6 03	5 57	5 50	5 42	5 33	5 23	5 12	4 59	4 44	4 25	4 02
28	7 21	7 16	7 10	7 04	6 57	6 50	6 42	6 33	6 23	6 11	5 57	5 42	5 22	4 58
29	8 26	8 21	8 16	8 10	8 04	7 57	7 49	7 41	7 31	7 21	7 08	6 54	6 36	6 14
30	9 32	9 28	9 23	9 18	9 13	9 07	9 01	8 54	8 46	8 37	8 27	8 15	8 01	7 44
31	10 38	10 34	10 31	10 27	10 23	10 18	10 14	10 08	10 02	9 56	9 48	9 39	9 29	9 17
June 1	11 41	11 39	11 37	11 34	11 31	11 28	11 25	11 21	11 18	11 13	11 08	11 02	10 56	10 48
2	12 43	12 42	12 40	12 39	12 38	12 36	12 35	12 33	12 31	12 29	12 26	12 23	12 20	12 17
3	13 42	13 42	13 42	13 42	13 42	13 42	13 42	13 42	13 42	13 42	13 42	13 42	13 42	13 42
4	14 41	14 42	14 43	14 44	14 45	14 47	14 48	14 50	14 52	14 54	14 56	14 59	15 02	15 06
5	15 38	15 40	15 42	15 45	15 47	15 50	15 53	15 57	16 00	16 04	16 09	16 15	16 21	16 28
6	16 35	16 38	16 41	16 45	16 48	16 53	16 57	17 02	17 08	17 14	17 21	17 29	17 38	17 49
7	17 31	17 35	17 39	17 43	17 48	17 54	18 00	18 06	18 13	18 22	18 31	18 42	18 54	19 10
8	18 26	18 30	18 35	18 41	18 47	18 53	19 00	19 08	19 17	19 26	19 38	19 51	20 07	20 27
9	19 19	19 24	19 30	19 36	19 42	19 49	19 57	20 06	20 16	20 27	20 40	20 55	21 14	21 37
10	20 10	20 15	20 21	20 27	20 34	20 41	20 50	20 59	21 09	21 21	21 35	21 51	22 11	22 36

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
May 17	10 01	9 57	9 52	9 47	9 41	9 35	9 28	9 21	9 12	9 03	8 52	8 39	8 24	8 05
18	11 00	10 56	10 52	10 48	10 43	10 38	10 32	10 26	10 19	10 12	10 03	9 53	9 41	9 27
19	12 00	11 58	11 55	11 51	11 48	11 44	11 40	11 36	11 31	11 25	11 19	11 12	11 04	10 54
20	13 03	13 02	13 00	12 58	12 56	12 54	12 51	12 49	12 46	12 43	12 39	12 35	12 30	12 24
21	14 09	14 08	14 08	14 07	14 07	14 06	14 06	14 05	14 04	14 03	14 02	14 01	14 00	13 58
22	15 17	15 18	15 19	15 20	15 21	15 22	15 23	15 24	15 26	15 27	15 29	15 31	15 33	15 36
23	16 28	16 30	16 32	16 34	16 37	16 40	16 43	16 46	16 50	16 54	16 59	17 04	17 10	17 17
24	17 40	17 44	17 47	17 51	17 55	18 00	18 05	18 10	18 16	18 23	18 30	18 39	18 49	19 01
25	18 54	18 58	19 03	19 08	19 13	19 19	19 26	19 33	19 41	19 50	20 01	20 13	20 27	20 45
26	20 05	20 10	20 15	20 21	20 28	20 35	20 43	20 51	21 01	21 12	21 24	21 39	21 57	22 20
27	21 11	21 16	21 22	21 28	21 35	21 43	21 51	22 00	22 10	22 22	22 35	22 51	23 10	23 35
28	22 10	22 15	22 21	22 27	22 33	22 40	22 48	22 56	23 06	23 17	23 30	23 45	.. ..	.. ..
29	23 01	23 05	23 10	23 15	23 21	23 27	23 34	23 41	23 50	23 59	.. ..	.. ..	0 02	0 25
30	23 45	23 48	23 52	23 56	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 10	0 22	0 37	0 54
31	.. ..	.. ..	.. ..	.. ..	0 01	0 06	0 11	0 17	0 23	0 31	0 39	0 48	0 59	1 12
June 1	0 22	0 25	0 28	0 31	0 34	0 38	0 42	0 46	0 50	0 56	1 01	1 08	1 15	1 24
2	0 56	0 58	0 59	1 01	1 03	1 05	1 08	1 10	1 13	1 16	1 19	1 23	1 28	1 33
3	1 27	1 28	1 28	1 29	1 30	1 30	1 31	1 32	1 33	1 34	1 35	1 36	1 38	1 39
4	1 57	1 56	1 56	1 55	1 55	1 54	1 53	1 53	1 52	1 51	1 50	1 48	1 47	1 46
5	2 26	2 25	2 23	2 22	2 20	2 18	2 16	2 13	2 11	2 08	2 04	2 01	1 56	1 52
6	2 57	2 54	2 52	2 49	2 46	2 42	2 39	2 35	2 30	2 26	2 20	2 14	2 07	1 59
7	3 29	3 25	3 22	3 18	3 14	3 09	3 04	2 59	2 53	2 46	2 38	2 29	2 19	2 07
8	4 04	3 59	3 55	3 50	3 45	3 39	3 33	3 26	3 18	3 10	3 00	2 49	2 35	2 19
9	4 42	4 37	4 32	4 26	4 20	4 14	4 06	3 58	3 49	3 39	3 27	3 14	2 57	2 37
10	5 24	5 19	5 13	5 07	5 00	4 53	4 45	4 36	4 26	4 15	4 02	3 46	3 28	3 04

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
June 8	15 39	15 57	16 11	16 23	16 33	16 42	16 58	17 11	17 24	17 37	17 50	18 06	18 15	18 26
9	16 13	16 34	16 50	17 03	17 15	17 25	17 42	17 57	18 11	18 25	18 40	18 57	19 07	19 19
10	16 55	17 17	17 34	17 48	18 00	18 10	18 28	18 44	18 59	19 13	19 29	19 47	19 58	20 10
11	17 43	18 05	18 22	18 36	18 48	18 59	19 17	19 32	19 47	20 01	20 17	20 35	20 45	20 57
12	18 39	19 00	19 16	19 29	19 40	19 50	20 07	20 21	20 35	20 49	21 03	21 20	21 30	21 41
13	19 41	19 59	20 13	20 25	20 34	20 43	20 58	21 11	21 23	21 35	21 48	22 03	22 11	22 21
14	20 48	21 02	21 13	21 23	21 31	21 38	21 50	22 01	22 11	22 21	22 31	22 43	22 50	22 58
15	21 57	22 08	22 16	22 23	22 29	22 34	22 43	22 51	22 58	23 05	23 13	23 22	23 27	23 33
16	23 10	23 16	23 21	23 25	23 28	23 31	23 36	23 41	23 45	23 50	23 54	23 59	.. ..	.. ..
17	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 02	0 06
18	0 25	0 27	0 28	0 29	0 29	0 30	0 31	0 32	0 33	0 34	0 35	0 37	0 37	0 38
19	1 43	1 40	1 37	1 35	1 33	1 31	1 28	1 25	1 23	1 21	1 18	1 15	1 14	1 12
20	3 04	2 56	2 49	2 43	2 39	2 34	2 27	2 21	2 15	2 09	2 03	1 56	1 52	1 47
21	4 27	4 14	4 03	3 54	3 47	3 40	3 29	3 19	3 10	3 01	2 51	2 40	2 34	2 27
22	5 50	5 32	5 18	5 06	4 56	4 48	4 33	4 20	4 08	3 56	3 43	3 29	3 21	3 11
23	7 09	6 48	6 31	6 17	6 06	5 56	5 38	5 23	5 09	4 55	4 40	4 23	4 14	4 02
24	8 19	7 56	7 39	7 24	7 12	7 01	6 43	6 27	6 12	5 57	5 41	5 23	5 13	5 01
25	9 17	8 55	8 38	8 24	8 13	8 02	7 44	7 29	7 14	7 00	6 45	6 27	6 16	6 05
26	10 02	9 44	9 29	9 17	9 06	8 57	8 41	8 27	8 15	8 02	7 48	7 32	7 23	7 12
27	10 38	10 23	10 11	10 01	9 53	9 46	9 33	9 22	9 11	9 00	8 49	8 36	8 29	8 20
28	11 06	10 56	10 47	10 40	10 34	10 29	10 20	10 11	10 04	9 56	9 48	9 38	9 33	9 27
29	11 30	11 24	11 19	11 15	11 11	11 08	11 02	10 58	10 53	10 48	10 44	10 38	10 35	10 31
30	11 51	11 49	11 47	11 46	11 45	11 44	11 42	11 41	11 40	11 38	11 37	11 35	11 34	11 33
July 1	12 11	12 13	12 15	12 16	12 17	12 19	12 21	12 23	12 24	12 26	12 28	12 30	12 31	12 33
2	12 31	12 37	12 42	12 46	12 50	12 53	12 58	13 03	13 08	13 13	13 18	13 24	13 27	13 31

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
June 8	6 40	6 22	6 09	5 57	5 48	5 39	5 25	5 12	5 00	4 48	4 36	4 21	4 13	4 04
9	7 40	7 20	7 05	6 52	6 41	6 31	6 14	6 00	5 47	5 33	5 19	5 02	4 53	4 42
10	8 36	8 15	7 58	7 44	7 32	7 21	7 04	6 48	6 34	6 19	6 04	5 46	5 36	5 24
11	9 26	9 04	8 47	8 33	8 21	8 10	7 52	7 37	7 22	7 07	6 51	6 33	6 23	6 11
12	10 09	9 48	9 32	9 18	9 07	8 57	8 39	8 24	8 10	7 56	7 41	7 23	7 13	7 01
13	10 46	10 27	10 13	10 00	9 50	9 41	9 25	9 11	8 58	8 45	8 31	8 15	8 06	7 55
14	11 17	11 01	10 49	10 39	10 30	10 22	10 09	9 57	9 46	9 35	9 23	9 09	9 01	8 52
15	11 43	11 32	11 22	11 14	11 08	11 02	10 51	10 42	10 33	10 25	10 15	10 05	9 58	9 51
16	12 07	11 59	11 53	11 48	11 43	11 39	11 33	11 26	11 21	11 15	11 08	11 01	10 57	10 52
17	12 29	12 26	12 23	12 21	12 19	12 17	12 14	12 11	12 08	12 05	12 03	11 59	11 57	11 55
18	12 51	12 52	12 53	12 53	12 54	12 54	12 55	12 56	12 57	12 57	12 58	12 59	12 59	13 00
19	13 14	13 19	13 24	13 28	13 31	13 34	13 39	13 43	13 47	13 51	13 56	14 01	14 04	14 07
20	13 39	13 50	13 58	14 05	14 11	14 16	14 25	14 33	14 41	14 48	14 56	15 05	15 11	15 17
21	14 10	14 25	14 36	14 46	14 55	15 02	15 15	15 26	15 37	15 48	15 59	16 12	16 20	16 28
22	14 48	15 07	15 22	15 34	15 44	15 54	16 10	16 24	16 37	16 50	17 04	17 20	17 29	17 40
23	15 36	15 57	16 15	16 29	16 40	16 51	17 09	17 24	17 39	17 54	18 09	18 27	18 37	18 49
24	16 35	16 58	17 15	17 30	17 42	17 53	18 11	18 27	18 42	18 57	19 12	19 31	19 41	19 53
25	17 45	18 06	18 23	18 36	18 48	18 58	19 15	19 30	19 43	19 57	20 12	20 29	20 38	20 50
26	19 01	19 19	19 33	19 44	19 54	20 03	20 17	20 30	20 42	20 54	21 06	21 21	21 29	21 38
27	20 19	20 33	20 43	20 52	21 00	21 06	21 18	21 27	21 37	21 46	21 55	22 06	22 13	22 20
28	21 36	21 45	21 52	21 58	22 03	22 07	22 15	22 21	22 28	22 34	22 40	22 48	22 52	22 56
29	22 51	22 55	22 58	23 01	23 04	23 06	23 09	23 13	23 16	23 18	23 22	23 25	23 27	23 29
30	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
July 1	0 02	0 02	0 02	0 02	0 02	0 02	0 02	0 01	0 01	0 01	0 01	0 00	0 00	0 00
2	1 12	1 08	1 04	1 01	0 58	0 56	0 52	0 49	0 45	0 42	0 39	0 35	0 32	0 30

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
June 8	18 26	18 30	18 35	18 41	18 47	18 53	19 00	19 08	19 17	19 26	19 38	19 51	20 07	20 27
9	19 19	19 24	19 30	19 36	19 42	19 49	19 57	20 06	20 16	20 27	20 40	20 55	21 14	21 37
10	20 10	20 15	20 21	20 27	20 34	20 41	20 50	20 59	21 09	21 21	21 35	21 51	22 11	22 36
11	20 57	21 02	21 08	21 14	21 21	21 28	21 36	21 45	21 56	22 07	22 20	22 36	22 55	23 20
12	21 41	21 46	21 51	21 57	22 03	22 10	22 17	22 26	22 35	22 45	22 57	23 11	23 28	23 49
13	22 21	22 25	22 30	22 35	22 40	22 46	22 53	23 00	23 08	23 17	23 27	23 38	23 52	.. ..
14	22 58	23 02	23 05	23 09	23 14	23 18	23 24	23 29	23 35	23 42	23 50	23 59	.. ..	0 09
15	23 33	23 35	23 38	23 41	23 44	23 47	23 51	23 55	23 59	.. ..	.. ..	.. ..	0 10	0 22
16	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 04	0 10	0 16	0 24	0 32
17	0 06	0 07	0 09	0 10	0 12	0 14	0 16	0 19	0 21	0 24	0 27	0 31	0 35	0 40
18	0 38	0 39	0 39	0 39	0 40	0 40	0 41	0 42	0 42	0 43	0 44	0 45	0 46	0 47
19	1 12	1 11	1 10	1 09	1 08	1 07	1 06	1 05	1 03	1 02	1 00	0 58	0 56	0 54
20	1 47	1 45	1 43	1 41	1 39	1 36	1 33	1 30	1 27	1 23	1 19	1 14	1 08	1 02
21	2 27	2 24	2 20	2 17	2 13	2 09	2 04	1 59	1 53	1 47	1 40	1 33	1 23	1 13
22	3 11	3 07	3 03	2 58	2 53	2 47	2 41	2 34	2 26	2 18	2 08	1 57	1 44	1 29
23	4 02	3 57	3 52	3 46	3 40	3 33	3 26	3 18	3 08	2 58	2 46	2 32	2 15	1 54
24	5 01	4 55	4 49	4 43	4 37	4 29	4 21	4 12	4 02	3 50	3 37	3 21	3 01	2 37
25	6 05	5 59	5 54	5 48	5 41	5 34	5 26	5 17	5 07	4 55	4 42	4 27	4 08	3 44
26	7 12	7 07	7 02	6 57	6 51	6 45	6 38	6 30	6 21	6 11	5 59	5 46	5 30	5 10
27	8 20	8 16	8 12	8 08	8 03	7 58	7 52	7 46	7 39	7 31	7 22	7 12	7 00	6 45
28	9 27	9 24	9 21	9 18	9 15	9 11	9 07	9 03	8 58	8 52	8 46	8 39	8 31	8 21
29	10 31	10 30	10 28	10 26	10 24	10 22	10 20	10 17	10 14	10 11	10 08	10 04	9 59	9 54
30	11 33	11 33	11 32	11 32	11 31	11 30	11 30	11 29	11 28	11 27	11 26	11 25	11 24	11 22
July 1	12 33	12 33	12 34	12 35	12 36	12 37	12 37	12 39	12 40	12 41	12 42	12 44	12 46	12 48
2	13 31	13 33	13 35	13 37	13 39	13 41	13 43	13 46	13 49	13 53	13 56	14 01	14 06	14 11

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
June 8	4 04	3 59	3 55	3 50	3 45	3 39	3 33	3 26	3 18	3 10	3 00	2 49	2 35	2 19
9	4 42	4 37	4 32	4 26	4 20	4 14	4 06	3 58	3 49	3 39	3 27	3 14	2 57	2 37
10	5 24	5 19	5 13	5 07	5 00	4 53	4 45	4 36	4 26	4 15	4 02	3 46	3 28	3 04
11	6 11	6 05	5 59	5 53	5 46	5 39	5 31	5 21	5 11	4 59	4 46	4 29	4 09	3 44
12	7 01	6 56	6 50	6 44	6 38	6 30	6 22	6 14	6 04	5 52	5 39	5 23	5 04	4 40
13	7 55	7 50	7 45	7 40	7 34	7 27	7 20	7 12	7 03	6 53	6 41	6 27	6 11	5 50
14	8 52	8 48	8 44	8 39	8 34	8 28	8 22	8 16	8 08	8 00	7 50	7 39	7 26	7 10
15	9 51	9 48	9 45	9 41	9 37	9 33	9 28	9 23	9 17	9 11	9 04	8 55	8 46	8 34
16	10 52	10 50	10 48	10 45	10 43	10 40	10 37	10 34	10 30	10 26	10 21	10 15	10 09	10 02
17	11 55	11 54	11 53	11 52	11 51	11 49	11 48	11 46	11 45	11 43	11 41	11 38	11 35	11 32
18	13 00	13 00	13 00	13 01	13 01	13 01	13 01	13 02	13 02	13 03	13 03	13 04	13 04	13 05
19	14 07	14 09	14 10	14 12	14 14	14 15	14 18	14 20	14 22	14 25	14 29	14 32	14 36	14 41
20	15 17	15 19	15 22	15 25	15 29	15 32	15 36	15 41	15 45	15 51	15 57	16 04	16 12	16 21
21	16 28	16 32	16 36	16 41	16 45	16 51	16 56	17 03	17 10	17 17	17 26	17 37	17 49	18 04
22	17 40	17 45	17 50	17 55	18 01	18 08	18 15	18 23	18 32	18 42	18 54	19 07	19 24	19 44
23	18 49	18 55	19 00	19 06	19 13	19 20	19 28	19 37	19 47	19 59	20 12	20 28	20 47	21 11
24	19 53	19 58	20 04	20 10	20 17	20 24	20 33	20 42	20 52	21 03	21 17	21 32	21 52	22 16
25	20 50	20 54	21 00	21 05	21 12	21 18	21 26	21 34	21 43	21 53	22 05	22 19	22 36	22 56
26	21 38	21 42	21 47	21 51	21 57	22 02	22 08	22 15	22 22	22 31	22 40	22 51	23 04	23 20
27	22 20	22 23	22 26	22 30	22 34	22 38	22 43	22 48	22 53	22 59	23 06	23 14	23 24	23 34
28	22 56	22 59	23 01	23 03	23 06	23 08	23 11	23 15	23 18	23 22	23 27	23 32	23 38	23 44
29	23 29	23 30	23 31	23 33	23 34	23 35	23 36	23 38	23 40	23 42	23 44	23 46	23 49	23 52
30	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 59	23 59	23 59	23 59	23 59	23 59	23 58	23 58
July 1	0 00	0 00	0 00	0 00	0 00	0 00	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
2	0 30	0 29	0 28	0 26	0 25	0 23	0 22	0 20	0 18	0 16	0 13	0 11	0 08	0 04

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 1	12 11	12 13	12 15	12 16	12 17	12 19	12 21	12 23	12 24	12 26	12 28	12 30	12 31	12 33
2	12 31	12 37	12 42	12 46	12 50	12 53	12 58	13 03	13 08	13 13	13 18	13 24	13 27	13 31
3	12 52	13 02	13 10	13 16	13 22	13 27	13 36	13 44	13 52	13 59	14 08	14 17	14 22	14 28
4	13 15	13 29	13 40	13 49	13 57	14 04	14 16	14 26	14 36	14 46	14 57	15 09	15 16	15 25
5	13 42	13 59	14 13	14 24	14 33	14 42	14 57	15 09	15 21	15 33	15 46	16 01	16 10	16 20
6	14 14	14 34	14 50	15 02	15 13	15 23	15 40	15 54	16 08	16 21	16 36	16 53	17 03	17 14
7	14 53	15 15	15 31	15 45	15 57	16 07	16 25	16 41	16 55	17 10	17 25	17 43	17 54	18 06
8	15 39	16 01	16 18	16 33	16 45	16 55	17 13	17 29	17 44	17 58	18 14	18 32	18 43	18 55
9	16 33	16 54	17 10	17 24	17 36	17 46	18 03	18 18	18 32	18 46	19 01	19 19	19 29	19 40
10	17 33	17 52	18 07	18 19	18 29	18 39	18 54	19 08	19 21	19 34	19 47	20 03	20 12	20 22
11	18 39	18 54	19 07	19 17	19 26	19 33	19 46	19 58	20 09	20 20	20 31	20 44	20 52	21 00
12	19 48	19 59	20 09	20 17	20 23	20 29	20 39	20 48	20 56	21 05	21 13	21 23	21 29	21 36
13	20 59	21 07	21 13	21 18	21 22	21 26	21 32	21 38	21 43	21 49	21 55	22 01	22 05	22 09
14	22 13	22 16	22 18	22 20	22 22	22 23	22 26	22 28	22 31	22 33	22 35	22 38	22 39	22 41
15	23 28	23 27	23 25	23 24	23 23	23 22	23 21	23 20	23 19	23 17	23 16	23 15	23 14	23 13
16	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 59	23 54	23 50	23 47
17	0 46	0 39	0 34	0 30	0 26	0 23	0 17	0 13	0 08	0 04	.. ..	.. ..	.. ..	.. ..
18	2 05	1 54	1 45	1 37	1 31	1 26	1 16	1 08	1 00	0 52	0 44	0 35	0 29	0 23
19	3 25	3 10	2 57	2 47	2 38	2 30	2 17	2 05	1 55	1 44	1 33	1 20	1 12	1 04
20	4 44	4 24	4 09	3 56	3 45	3 36	3 20	3 06	2 53	2 39	2 26	2 10	2 01	1 50
21	5 57	5 35	5 18	5 04	4 52	4 41	4 23	4 08	3 53	3 39	3 23	3 05	2 55	2 43
22	7 01	6 38	6 21	6 07	5 54	5 44	5 26	5 10	4 55	4 40	4 24	4 06	3 56	3 44
23	7 53	7 32	7 16	7 03	6 52	6 42	6 25	6 10	5 56	5 42	5 27	5 10	5 00	4 49
24	8 33	8 17	8 03	7 52	7 42	7 34	7 20	7 07	6 55	6 43	6 30	6 16	6 07	5 58
25	9 06	8 53	8 43	8 34	8 27	8 21	8 10	8 00	7 51	7 41	7 32	7 20	7 14	7 06

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 1	0 02	0 02	0 02	0 02	0 02	0 02	0 02	0 01	0 01	0 01	0 01	0 00	0 00	0 00
2	1 12	1 08	1 04	1 01	0 58	0 56	0 52	0 49	0 45	0 42	0 39	0 35	0 32	0 30
3	2 20	2 11	2 04	1 59	1 54	1 49	1 42	1 35	1 29	1 23	1 16	1 09	1 05	1 00
4	3 26	3 14	3 04	2 55	2 48	2 42	2 31	2 22	2 13	2 04	1 55	1 44	1 38	1 31
5	4 31	4 15	4 02	3 51	3 42	3 34	3 21	3 09	2 58	2 47	2 35	2 22	2 14	2 05
6	5 33	5 14	4 58	4 46	4 36	4 26	4 10	3 57	3 44	3 31	3 17	3 01	2 52	2 42
7	6 31	6 09	5 53	5 39	5 27	5 17	5 00	4 45	4 31	4 16	4 01	3 44	3 34	3 22
8	7 23	7 01	6 44	6 30	6 18	6 07	5 49	5 33	5 19	5 04	4 48	4 30	4 19	4 07
9	8 09	7 48	7 31	7 17	7 05	6 55	6 37	6 22	6 07	5 53	5 37	5 19	5 09	4 57
10	8 48	8 29	8 13	8 00	7 50	7 40	7 24	7 09	6 56	6 42	6 28	6 11	6 01	5 50
11	9 21	9 05	8 51	8 40	8 31	8 23	8 08	7 56	7 44	7 32	7 19	7 05	6 56	6 46
12	9 49	9 36	9 26	9 17	9 10	9 03	8 51	8 41	8 32	8 22	8 12	8 00	7 53	7 45
13	10 14	10 05	9 57	9 51	9 46	9 41	9 33	9 26	9 19	9 12	9 05	8 56	8 51	8 46
14	10 36	10 31	10 27	10 24	10 21	10 18	10 14	10 10	10 06	10 02	9 58	9 53	9 51	9 47
15	10 57	10 57	10 56	10 56	10 55	10 55	10 54	10 54	10 53	10 53	10 52	10 51	10 51	10 50
16	11 19	11 23	11 26	11 29	11 31	11 33	11 36	11 39	11 42	11 45	11 48	11 51	11 53	11 55
17	11 43	11 51	11 58	12 03	12 08	12 12	12 20	12 26	12 32	12 38	12 45	12 53	12 57	13 02
18	12 10	12 22	12 33	12 41	12 49	12 55	13 06	13 16	13 25	13 35	13 45	13 56	14 03	14 10
19	12 43	13 00	13 13	13 24	13 34	13 42	13 57	14 10	14 22	14 34	14 47	15 01	15 10	15 20
20	13 24	13 44	14 01	14 14	14 25	14 35	14 52	15 07	15 21	15 35	15 50	16 07	16 17	16 28
21	14 16	14 39	14 56	15 11	15 23	15 33	15 52	16 08	16 22	16 37	16 53	17 11	17 22	17 34
22	15 20	15 42	16 00	16 14	16 26	16 36	16 54	17 10	17 24	17 39	17 54	18 12	18 22	18 34
23	16 33	16 53	17 09	17 21	17 32	17 41	17 57	18 11	18 24	18 37	18 51	19 07	19 16	19 26
24	17 52	18 08	18 20	18 30	18 39	18 47	19 00	19 11	19 22	19 33	19 44	19 57	20 04	20 12
25	19 11	19 22	19 31	19 39	19 45	19 50	20 00	20 08	20 16	20 24	20 32	20 41	20 46	20 52

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 1	12 33	12 33	12 34	12 35	12 36	12 37	12 37	12 39	12 40	12 41	12 42	12 44	12 46	12 48
2	13 31	13 33	13 35	13 37	13 39	13 41	13 43	13 46	13 49	13 53	13 56	14 01	14 06	14 11
3	14 28	14 31	14 34	14 37	14 40	14 44	14 48	14 52	14 57	15 03	15 09	15 16	15 24	15 34
4	15 25	15 28	15 32	15 36	15 41	15 46	15 51	15 57	16 04	16 11	16 20	16 29	16 41	16 55
5	16 20	16 24	16 29	16 34	16 40	16 46	16 52	17 00	17 08	17 17	17 28	17 40	17 55	18 13
6	17 14	17 19	17 24	17 30	17 36	17 43	17 51	17 59	18 09	18 20	18 32	18 47	19 04	19 27
7	18 06	18 11	18 17	18 23	18 30	18 37	18 45	18 54	19 05	19 16	19 30	19 46	20 05	20 31
8	18 55	19 00	19 06	19 12	19 19	19 26	19 35	19 44	19 54	20 06	20 19	20 35	20 55	21 20
9	19 40	19 45	19 51	19 57	20 03	20 10	20 18	20 27	20 36	20 47	21 00	21 15	21 32	21 55
10	20 22	20 27	20 31	20 37	20 42	20 49	20 55	21 03	21 11	21 21	21 32	21 44	21 59	22 18
11	21 00	21 04	21 08	21 13	21 17	21 22	21 28	21 34	21 41	21 49	21 57	22 07	22 19	22 33
12	21 36	21 39	21 42	21 45	21 48	21 52	21 57	22 01	22 06	22 12	22 18	22 25	22 34	22 44
13	22 09	22 11	22 13	22 15	22 17	22 20	22 22	22 25	22 29	22 32	22 36	22 41	22 46	22 52
14	22 41	22 42	22 43	22 44	22 45	22 46	22 47	22 48	22 49	22 51	22 52	22 54	22 56	22 59
15	23 13	23 13	23 13	23 12	23 12	23 11	23 11	23 10	23 10	23 09	23 08	23 08	23 07	23 06
16	23 47	23 46	23 44	23 42	23 40	23 38	23 36	23 34	23 31	23 28	23 25	23 22	23 18	23 13
17	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 55	23 50	23 45	23 38	23 31	23 22
18	0 23	0 21	0 18	0 15	0 12	0 08	0 04	0 00	.. ..	.. ..	.. ..	23 59	23 48	23 35
19	1 04	1 00	0 56	0 52	0 47	0 42	0 37	0 31	0 24	0 17	0 09	.. ..	.. ..	23 54
20	1 50	1 46	1 41	1 35	1 30	1 23	1 16	1 09	1 00	0 51	0 40	0 27	0 12	.. ..
21	2 43	2 38	2 33	2 27	2 20	2 13	2 05	1 56	1 46	1 35	1 22	1 07	0 49	0 26
22	3 44	3 38	3 32	3 26	3 19	3 12	3 04	2 55	2 45	2 33	2 19	2 03	1 44	1 19
23	4 49	4 44	4 39	4 33	4 27	4 20	4 12	4 03	3 54	3 43	3 30	3 16	2 58	2 36
24	5 58	5 53	5 49	5 44	5 38	5 33	5 26	5 19	5 11	5 02	4 52	4 40	4 25	4 08
25	7 06	7 03	7 00	6 56	6 52	6 47	6 42	6 37	6 31	6 24	6 17	6 08	5 58	5 46

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 1	0 00	0 00	0 00	0 00	0 00	0 00	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
2	0 30	0 29	0 28	0 26	0 25	0 23	0 22	0 20	0 18	0 16	0 13	0 11	0 08	0 04
3	1 00	0 58	0 56	0 53	0 50	0 48	0 45	0 41	0 37	0 33	0 29	0 24	0 18	0 11
4	1 31	1 28	1 25	1 21	1 18	1 14	1 09	1 04	0 59	0 53	0 46	0 38	0 29	0 19
5	2 05	2 01	1 57	1 52	1 47	1 42	1 36	1 30	1 23	1 15	1 06	0 56	0 43	0 29
6	2 42	2 37	2 32	2 27	2 21	2 15	2 08	2 00	1 52	1 42	1 31	1 18	1 03	0 44
7	3 22	3 17	3 12	3 06	2 59	2 52	2 44	2 36	2 26	2 15	2 02	1 47	1 29	1 07
8	4 07	4 02	3 56	3 50	3 43	3 36	3 27	3 18	3 08	2 56	2 43	2 27	2 07	1 42
9	4 57	4 51	4 46	4 39	4 33	4 25	4 17	4 08	3 58	3 46	3 33	3 17	2 57	2 32
10	5 50	5 45	5 40	5 34	5 28	5 21	5 13	5 05	4 56	4 45	4 32	4 18	4 00	3 38
11	6 46	6 42	6 38	6 33	6 27	6 21	6 15	6 07	5 59	5 50	5 40	5 28	5 13	4 56
12	7 45	7 42	7 38	7 34	7 30	7 25	7 20	7 14	7 08	7 01	6 53	6 43	6 32	6 19
13	8 46	8 43	8 41	8 38	8 35	8 31	8 28	8 24	8 19	8 14	8 09	8 02	7 55	7 46
14	9 47	9 46	9 45	9 43	9 41	9 39	9 37	9 35	9 33	9 30	9 27	9 23	9 19	9 15
15	10 50	10 50	10 50	10 50	10 50	10 49	10 49	10 49	10 48	10 48	10 47	10 47	10 46	10 45
16	11 55	11 56	11 57	11 58	12 00	12 01	12 02	12 04	12 05	12 07	12 09	12 12	12 15	12 18
17	13 02	13 04	13 06	13 09	13 11	13 14	13 18	13 21	13 25	13 29	13 34	13 40	13 46	13 53
18	14 10	14 13	14 17	14 21	14 25	14 29	14 34	14 40	14 46	14 53	15 00	15 09	15 19	15 32
19	15 20	15 24	15 29	15 34	15 39	15 45	15 51	15 59	16 07	16 16	16 26	16 38	16 53	17 10
20	16 28	16 33	16 39	16 45	16 51	16 58	17 06	17 14	17 24	17 35	17 47	18 02	18 20	18 43
21	17 34	17 39	17 45	17 51	17 58	18 05	18 14	18 23	18 33	18 45	18 58	19 14	19 34	19 58
22	18 34	18 39	18 44	18 50	18 57	19 04	19 12	19 21	19 30	19 42	19 54	20 09	20 28	20 50
23	19 26	19 31	19 36	19 41	19 47	19 53	20 00	20 07	20 16	20 25	20 36	20 49	21 04	21 22
24	20 12	20 16	20 20	20 24	20 29	20 34	20 39	20 45	20 51	20 59	21 07	21 17	21 28	21 41
25	20 52	20 55	20 57	21 00	21 04	21 07	21 11	21 15	21 20	21 25	21 30	21 37	21 44	21 53

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 24	8 33	8 17	8 03	7 52	7 42	7 34	7 20	7 07	6 55	6 43	6 30	6 16	6 07	5 58
25	9 06	8 53	8 43	8 34	8 27	8 21	8 10	8 00	7 51	7 41	7 32	7 20	7 14	7 06
26	9 32	9 24	9 17	9 12	9 07	9 03	8 55	8 49	8 43	8 37	8 30	8 23	8 18	8 13
27	9 55	9 51	9 48	9 45	9 43	9 41	9 38	9 35	9 32	9 29	9 26	9 22	9 20	9 18
28	10 16	10 16	10 16	10 17	10 17	10 17	10 18	10 18	10 18	10 19	10 19	10 20	10 20	10 20
29	10 36	10 40	10 44	10 47	10 50	10 52	10 56	11 00	11 04	11 07	11 11	11 15	11 18	11 20
30	10 57	11 05	11 12	11 18	11 23	11 27	11 35	11 42	11 48	11 54	12 01	12 09	12 14	12 19
31	11 19	11 32	11 41	11 50	11 57	12 03	12 14	12 23	12 32	12 41	12 51	13 02	13 09	13 16
Aug. 1	11 45	12 01	12 13	12 24	12 33	12 41	12 54	13 06	13 17	13 29	13 41	13 55	14 03	14 12
2	12 15	12 34	12 49	13 01	13 11	13 21	13 36	13 50	14 03	14 16	14 31	14 47	14 56	15 07
3	12 51	13 12	13 29	13 42	13 54	14 04	14 21	14 36	14 50	15 05	15 20	15 38	15 48	15 59
4	13 34	13 56	14 14	14 28	14 40	14 50	15 08	15 24	15 39	15 53	16 09	16 27	16 38	16 50
5	14 25	14 47	15 04	15 18	15 29	15 40	15 57	16 13	16 27	16 42	16 57	17 15	17 25	17 37
6	15 24	15 43	15 59	16 12	16 23	16 32	16 49	17 03	17 16	17 30	17 44	18 00	18 09	18 20
7	16 28	16 45	16 58	17 09	17 19	17 27	17 41	17 53	18 05	18 17	18 29	18 43	18 51	19 00
8	17 37	17 50	18 01	18 09	18 17	18 23	18 34	18 44	18 53	19 02	19 12	19 23	19 30	19 37
9	18 49	18 58	19 05	19 11	19 16	19 20	19 28	19 35	19 41	19 48	19 54	20 02	20 06	20 11
10	20 02	20 07	20 10	20 13	20 16	20 18	20 22	20 26	20 29	20 32	20 36	20 39	20 42	20 44
11	21 18	21 17	21 17	21 17	21 17	21 17	21 17	21 17	21 17	21 17	21 17	21 17	21 17	21 17
12	22 34	22 29	22 25	22 22	22 19	22 17	22 13	22 09	22 06	22 02	21 59	21 55	21 52	21 50
13	23 52	23 42	23 35	23 28	23 23	23 18	23 10	23 03	22 56	22 49	22 42	22 34	22 30	22 24
14	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 58	23 48	23 39	23 29	23 17	23 10	23 03
15	1 11	0 56	0 45	0 36	0 28	0 21	0 09	.. ..	.. ..	.. ..	.. ..	.. ..	23 55	23 45
16	2 28	2 10	1 55	1 43	1 33	1 24	1 09	0 56	0 44	0 31	0 18	0 04	.. ..	.. ..
17	3 41	3 20	3 03	2 50	2 38	2 28	2 10	1 55	1 41	1 27	1 12	0 55	0 45	0 34

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 24	17 52	18 08	18 20	18 30	18 39	18 47	19 00	19 11	19 22	19 33	19 44	19 57	20 04	20 12
25	19 11	19 22	19 31	19 39	19 45	19 50	20 00	20 08	20 16	20 24	20 32	20 41	20 46	20 52
26	20 29	20 35	20 40	20 45	20 48	20 52	20 57	21 02	21 06	21 11	21 16	21 21	21 24	21 27
27	21 44	21 46	21 47	21 48	21 49	21 50	21 52	21 53	21 54	21 56	21 57	21 58	21 59	22 00
28	22 56	22 53	22 51	22 49	22 48	22 47	22 44	22 42	22 40	22 38	22 36	22 34	22 32	22 31
29	.. ..	23 59	23 53	23 49	23 45	23 41	23 35	23 30	23 25	23 20	23 15	23 09	23 05	23 01
30	0 06	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 53	23 44	23 39	23 32
31	1 14	1 03	0 54	0 47	0 40	0 35	0 25	0 17	0 09	0 02	.. ..	.. ..	.. ..	.. ..
Aug. 1	2 19	2 05	1 53	1 43	1 35	1 28	1 15	1 04	0 54	0 44	0 33	0 21	0 13	0 05
2	3 23	3 05	2 50	2 39	2 29	2 20	2 05	1 52	1 40	1 27	1 14	0 59	0 51	0 41
3	4 22	4 02	3 46	3 32	3 21	3 11	2 54	2 40	2 26	2 12	1 58	1 41	1 31	1 20
4	5 17	4 55	4 38	4 24	4 12	4 02	3 44	3 28	3 14	2 59	2 43	2 26	2 15	2 03
5	6 06	5 44	5 27	5 13	5 01	4 50	4 32	4 17	4 02	3 47	3 32	3 14	3 03	2 51
6	6 47	6 27	6 11	5 58	5 47	5 37	5 20	5 05	4 51	4 37	4 22	4 05	3 55	3 43
7	7 23	7 05	6 51	6 39	6 29	6 21	6 06	5 52	5 40	5 27	5 14	4 58	4 49	4 39
8	7 53	7 39	7 27	7 18	7 10	7 02	6 50	6 39	6 28	6 18	6 07	5 54	5 46	5 38
9	8 19	8 09	8 00	7 53	7 47	7 42	7 32	7 24	7 16	7 08	7 00	6 50	6 45	6 38
10	8 42	8 36	8 31	8 27	8 23	8 20	8 14	8 09	8 04	7 59	7 54	7 48	7 45	7 41
11	9 04	9 02	9 00	8 59	8 58	8 57	8 55	8 53	8 52	8 50	8 48	8 46	8 45	8 44
12	9 26	9 28	9 30	9 32	9 33	9 34	9 36	9 38	9 40	9 42	9 43	9 46	9 47	9 48
13	9 48	9 55	10 01	10 05	10 09	10 13	10 19	10 24	10 29	10 34	10 40	10 46	10 50	10 54
14	10 14	10 25	10 34	10 41	10 48	10 54	11 04	11 12	11 21	11 29	11 38	11 48	11 54	12 00
15	10 43	10 59	11 11	11 22	11 30	11 38	11 52	12 03	12 14	12 26	12 37	12 51	12 59	13 08
16	11 20	11 39	11 55	12 07	12 18	12 27	12 43	12 58	13 11	13 24	13 38	13 55	14 04	14 15
17	12 06	12 28	12 45	12 59	13 11	13 22	13 39	13 55	14 10	14 24	14 40	14 57	15 08	15 20

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 24	5 58	5 53	5 49	5 44	5 38	5 33	5 26	5 19	5 11	5 02	4 52	4 40	4 25	4 08
25	7 06	7 03	7 00	6 56	6 52	6 47	6 42	6 37	6 31	6 24	6 17	6 08	5 58	5 46
26	8 13	8 11	8 09	8 07	8 04	8 01	7 58	7 54	7 50	7 46	7 41	7 36	7 30	7 22
27	9 18	9 17	9 16	9 15	9 14	9 12	9 11	9 09	9 08	9 06	9 04	9 01	8 58	8 55
28	10 20	10 21	10 21	10 21	10 21	10 21	10 21	10 22	10 22	10 22	10 23	10 23	10 24	10 24
29	11 20	11 22	11 23	11 25	11 26	11 28	11 30	11 32	11 34	11 36	11 39	11 42	11 46	11 50
30	12 19	12 21	12 24	12 26	12 29	12 32	12 36	12 39	12 44	12 48	12 53	12 59	13 06	13 14
31	13 16	13 19	13 23	13 27	13 31	13 35	13 40	13 45	13 51	13 58	14 06	14 14	14 24	14 36
Aug. 1	14 12	14 16	14 21	14 25	14 31	14 36	14 42	14 49	14 57	15 05	15 15	15 27	15 40	15 56
2	15 07	15 12	15 17	15 22	15 28	15 35	15 42	15 50	15 59	16 09	16 21	16 35	16 52	17 12
3	15 59	16 05	16 10	16 16	16 23	16 30	16 38	16 47	16 57	17 08	17 22	17 37	17 56	18 20
4	16 50	16 55	17 01	17 07	17 14	17 21	17 30	17 39	17 49	18 01	18 14	18 31	18 50	19 16
5	17 37	17 42	17 48	17 54	18 00	18 07	18 15	18 24	18 34	18 45	18 58	19 14	19 33	19 56
6	18 20	18 25	18 30	18 36	18 42	18 48	18 55	19 03	19 12	19 22	19 34	19 47	20 03	20 23
7	19 00	19 04	19 09	19 13	19 18	19 24	19 30	19 37	19 44	19 52	20 02	20 13	20 26	20 41
8	19 37	19 40	19 44	19 47	19 51	19 56	20 00	20 05	20 11	20 18	20 25	20 33	20 42	20 53
9	20 11	20 14	20 16	20 19	20 21	20 24	20 27	20 31	20 35	20 39	20 44	20 49	20 55	21 03
10	20 44	20 45	20 47	20 48	20 49	20 51	20 52	20 54	20 56	20 58	21 01	21 03	21 06	21 10
11	21 17	21 17	21 17	21 17	21 17	21 17	21 17	21 17	21 17	21 17	21 17	21 17	21 17	21 17
12	21 50	21 48	21 47	21 46	21 45	21 43	21 41	21 40	21 38	21 36	21 33	21 30	21 27	21 24
13	22 24	22 22	22 20	22 17	22 14	22 11	22 08	22 05	22 01	21 56	21 51	21 46	21 39	21 32
14	23 03	22 59	22 56	22 52	22 48	22 43	22 38	22 33	22 27	22 20	22 13	22 04	21 55	21 43
15	23 45	23 41	23 37	23 32	23 26	23 20	23 14	23 07	22 59	22 50	22 40	22 29	22 15	21 59
16	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 57	23 49	23 40	23 29	23 17	23 03	22 46	22 25
17	0 34	0 29	0 24	0 18	0 12	0 05	.. ..	.. ..	.. ..	.. ..	.. ..	23 50	23 31	23 07

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 24	20 12	20 16	20 20	20 24	20 29	20 34	20 39	20 45	20 51	20 59	21 07	21 17	21 28	21 41
25	20 52	20 55	20 57	21 00	21 04	21 07	21 11	21 15	21 20	21 25	21 30	21 37	21 44	21 53
26	21 27	21 29	21 31	21 32	21 34	21 36	21 38	21 41	21 43	21 46	21 49	21 53	21 57	22 02
27	22 00	22 00	22 01	22 01	22 02	22 02	22 03	22 03	22 04	22 05	22 06	22 07	22 08	22 09
28	22 31	22 30	22 29	22 29	22 28	22 27	22 26	22 25	22 24	22 22	22 21	22 19	22 17	22 15
29	23 01	23 00	22 58	22 56	22 54	22 51	22 49	22 46	22 43	22 40	22 36	22 32	22 27	22 22
30	23 32	23 30	23 27	23 24	23 20	23 17	23 13	23 09	23 04	22 59	22 53	22 46	22 38	22 29
31	.. ..	.. ..	23 58	23 54	23 49	23 44	23 39	23 33	23 27	23 20	23 12	23 02	22 51	22 39
Aug. 1	0 05	0 02	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 54	23 45	23 35	23 23	23 09	22 52
2	0 41	0 36	0 32	0 27	0 21	0 15	0 09	0 02	.. ..	.. ..	.. ..	23 49	23 32	23 11
3	1 20	1 15	1 10	1 04	0 58	0 51	0 43	0 35	0 26	0 15	0 03	.. ..	.. ..	23 41
4	2 03	1 58	1 52	1 46	1 39	1 32	1 24	1 15	1 05	0 53	0 40	0 24	0 05	.. ..
5	2 51	2 46	2 40	2 34	2 27	2 19	2 11	2 02	1 52	1 40	1 26	1 10	0 50	0 25
6	3 43	3 38	3 33	3 27	3 20	3 13	3 05	2 57	2 47	2 36	2 23	2 08	1 49	1 26
7	4 39	4 34	4 30	4 24	4 18	4 12	4 05	3 58	3 49	3 39	3 28	3 15	2 59	2 40
8	5 38	5 34	5 30	5 26	5 21	5 16	5 10	5 04	4 57	4 49	4 40	4 30	4 17	4 03
9	6 38	6 36	6 33	6 29	6 26	6 22	6 18	6 13	6 08	6 02	5 56	5 49	5 40	5 30
10	7 41	7 39	7 37	7 35	7 33	7 30	7 28	7 25	7 22	7 19	7 15	7 10	7 05	6 59
11	8 44	8 43	8 43	8 42	8 41	8 40	8 39	8 39	8 37	8 36	8 35	8 33	8 32	8 30
12	9 48	9 49	9 49	9 50	9 51	9 52	9 52	9 53	9 54	9 56	9 57	9 58	10 00	10 02
13	10 54	10 55	10 57	10 59	11 02	11 04	11 07	11 09	11 13	11 16	11 20	11 25	11 30	11 36
14	12 00	12 03	12 06	12 10	12 13	12 17	12 22	12 26	12 32	12 38	12 44	12 52	13 01	13 12
15	13 08	13 12	13 16	13 21	13 26	13 31	13 37	13 43	13 51	13 59	14 09	14 19	14 32	14 48
16	14 15	14 20	14 25	14 30	14 36	14 43	14 50	14 58	15 07	15 18	15 29	15 43	16 00	16 21
17	15 20	15 25	15 31	15 37	15 43	15 51	15 59	16 08	16 18	16 29	16 43	16 58	17 17	17 42

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Aug. 16	2 28	2 10	1 55	1 43	1 33	1 24	1 09	0 56	0 44	0 31	0 18	0 04	.. ..	.. ..
17	3 41	3 20	3 03	2 50	2 38	2 28	2 10	1 55	1 41	1 27	1 12	0 55	0 45	0 34
18	4 47	4 25	4 07	3 53	3 40	3 30	3 11	2 56	2 41	2 26	2 10	1 52	1 42	1 30
19	5 42	5 21	5 04	4 50	4 38	4 28	4 10	3 55	3 41	3 26	3 11	2 53	2 43	2 31
20	6 27	6 08	5 54	5 42	5 31	5 22	5 06	4 52	4 39	4 27	4 13	3 57	3 48	3 37
21	7 03	6 48	6 36	6 27	6 18	6 11	5 58	5 47	5 36	5 25	5 14	5 01	4 54	4 45
22	7 32	7 21	7 13	7 06	7 00	6 55	6 46	6 37	6 30	6 22	6 14	6 05	5 59	5 53
23	7 56	7 50	7 46	7 42	7 38	7 35	7 30	7 25	7 21	7 16	7 11	7 06	7 03	6 59
24	8 18	8 17	8 16	8 14	8 14	8 13	8 11	8 10	8 09	8 08	8 07	8 05	8 05	8 04
25	8 39	8 42	8 44	8 46	8 47	8 49	8 51	8 54	8 56	8 58	9 00	9 03	9 04	9 06
26	9 00	9 07	9 12	9 17	9 21	9 24	9 31	9 36	9 41	9 46	9 52	9 58	10 02	10 06
27	9 22	9 33	9 41	9 49	9 55	10 00	10 10	10 18	10 26	10 34	10 43	10 53	10 58	11 05
28	9 47	10 01	10 12	10 22	10 30	10 38	10 50	11 01	11 12	11 22	11 33	11 46	11 54	12 02
29	10 15	10 33	10 47	10 58	11 08	11 17	11 32	11 45	11 57	12 10	12 23	12 39	12 47	12 58
30	10 48	11 09	11 25	11 38	11 49	11 59	12 16	12 30	12 44	12 58	13 13	13 30	13 40	13 51
31	11 29	11 50	12 07	12 21	12 33	12 44	13 01	13 17	13 32	13 46	14 02	14 20	14 30	14 42
Sept. 1	12 16	12 38	12 55	13 09	13 21	13 32	13 50	14 05	14 20	14 35	14 50	15 08	15 19	15 31
2	13 12	13 32	13 49	14 02	14 13	14 23	14 40	14 55	15 09	15 23	15 37	15 54	16 04	16 15
3	14 14	14 32	14 46	14 58	15 08	15 17	15 32	15 45	15 58	16 10	16 23	16 38	16 47	16 57
4	15 22	15 36	15 48	15 58	16 06	16 13	16 26	16 36	16 47	16 57	17 08	17 20	17 27	17 35
5	16 33	16 44	16 52	16 59	17 05	17 11	17 20	17 28	17 35	17 43	17 51	18 00	18 05	18 11
6	17 48	17 54	17 59	18 03	18 06	18 09	18 15	18 19	18 24	18 28	18 33	18 38	18 41	18 45
7	19 04	19 05	19 07	19 08	19 08	19 09	19 10	19 12	19 13	19 14	19 15	19 16	19 17	19 18
8	20 22	20 18	20 16	20 13	20 12	20 10	20 07	20 04	20 02	20 00	19 57	19 54	19 53	19 51
9	21 41	21 33	21 26	21 20	21 16	21 12	21 05	20 58	20 53	20 47	20 41	20 34	20 30	20 26

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Aug. 16	11 20	11 39	11 55	12 07	12 18	12 27	12 43	12 58	13 11	13 24	13 38	13 55	14 04	14 15
17	12 06	12 28	12 45	12 59	13 11	13 22	13 39	13 55	14 10	14 24	14 40	14 57	15 08	15 20
18	13 03	13 26	13 43	13 58	14 10	14 21	14 39	14 55	15 09	15 24	15 40	15 58	16 08	16 20
19	14 11	14 32	14 48	15 02	15 13	15 23	15 40	15 55	16 09	16 23	16 37	16 54	17 04	17 15
20	15 26	15 44	15 58	16 09	16 19	16 27	16 42	16 55	17 07	17 19	17 31	17 45	17 54	18 03
21	16 45	16 58	17 09	17 17	17 25	17 32	17 43	17 53	18 02	18 11	18 21	18 32	18 38	18 45
22	18 03	18 12	18 19	18 25	18 30	18 34	18 42	18 48	18 54	19 00	19 07	19 14	19 18	19 23
23	19 21	19 25	19 28	19 30	19 33	19 35	19 38	19 41	19 44	19 47	19 50	19 53	19 55	19 57
24	20 35	20 35	20 34	20 34	20 33	20 33	20 33	20 32	20 32	20 31	20 30	20 30	20 29	20 29
25	21 48	21 43	21 38	21 35	21 32	21 30	21 25	21 21	21 18	21 14	21 10	21 06	21 03	21 00
26	22 57	22 48	22 41	22 35	22 29	22 25	22 17	22 10	22 03	21 56	21 49	21 41	21 37	21 31
27	.. ..	23 52	23 41	23 33	23 25	23 19	23 07	22 57	22 48	22 39	22 29	22 18	22 11	22 04
28	0 05	.. ..	.. ..	.. ..	.. ..	.. ..	23 57	23 45	23 34	23 22	23 10	22 56	22 48	22 39
29	1 10	0 53	0 40	0 29	0 20	0 11	.. ..	.. ..	.. ..	.. ..	23 53	23 36	23 27	23 16
30	2 11	1 52	1 36	1 24	1 13	1 03	0 47	0 33	0 20	0 07	.. ..	.. ..	.. ..	23 58
31	3 08	2 47	2 30	2 16	2 04	1 54	1 37	1 21	1 07	0 53	0 37	0 20	0 10	.. ..
Sept. 1	3 59	3 37	3 20	3 06	2 54	2 43	2 25	2 10	1 55	1 40	1 24	1 06	0 56	0 44
2	4 44	4 23	4 06	3 52	3 41	3 31	3 13	2 58	2 44	2 29	2 14	1 56	1 46	1 34
3	5 22	5 03	4 48	4 35	4 25	4 16	4 00	3 46	3 32	3 19	3 05	2 49	2 39	2 28
4	5 54	5 38	5 26	5 15	5 06	4 58	4 45	4 33	4 21	4 10	3 58	3 44	3 36	3 26
5	6 22	6 10	6 00	5 52	5 45	5 39	5 28	5 19	5 10	5 01	4 52	4 41	4 34	4 27
6	6 46	6 38	6 32	6 27	6 22	6 18	6 11	6 04	5 58	5 52	5 46	5 39	5 34	5 30
7	7 09	7 05	7 02	7 00	6 58	6 56	6 53	6 50	6 47	6 44	6 41	6 38	6 36	6 34
8	7 31	7 32	7 32	7 33	7 33	7 34	7 35	7 35	7 36	7 37	7 37	7 38	7 38	7 39
9	7 53	7 59	8 03	8 07	8 10	8 13	8 18	8 22	8 26	8 30	8 34	8 39	8 42	8 45

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Aug. 16	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 57	23 49	23 40	23 29	23 17	23 03	22 46	22 25
17	0 34	0 29	0 24	0 18	0 12	0 05	.. ..	.. ..	.. ..	.. ..	.. ..	23 50	23 31	23 07
18	1 30	1 24	1 19	1 12	1 06	0 58	0 50	0 41	0 31	0 19	0 06	.. ..	.. ..	.. ..
19	2 31	2 26	2 20	2 14	2 08	2 00	1 52	1 44	1 34	1 22	1 09	0 54	0 35	0 11
20	3 37	3 32	3 27	3 22	3 16	3 10	3 03	2 55	2 46	2 36	2 25	2 11	1 55	1 35
21	4 45	4 41	4 37	4 33	4 28	4 23	4 17	4 11	4 04	3 56	3 47	3 37	3 25	3 10
22	5 53	5 50	5 47	5 44	5 41	5 37	5 33	5 29	5 24	5 18	5 12	5 05	4 57	4 47
23	6 59	6 58	6 56	6 54	6 53	6 50	6 48	6 46	6 43	6 40	6 36	6 33	6 28	6 23
24	8 04	8 03	8 03	8 03	8 02	8 02	8 01	8 00	8 00	7 59	7 58	7 57	7 56	7 55
25	9 06	9 07	9 08	9 08	9 09	9 10	9 12	9 13	9 14	9 16	9 17	9 19	9 22	9 24
26	10 06	10 08	10 10	10 12	10 15	10 17	10 20	10 23	10 26	10 30	10 34	10 39	10 44	10 51
27	11 05	11 08	11 11	11 14	11 18	11 22	11 26	11 31	11 36	11 42	11 48	11 56	12 05	12 15
28	12 02	12 06	12 10	12 14	12 19	12 24	12 30	12 36	12 43	12 51	13 00	13 10	13 22	13 37
29	12 58	13 02	13 07	13 12	13 18	13 24	13 31	13 39	13 47	13 57	14 08	14 21	14 36	14 55
30	13 51	13 56	14 02	14 08	14 14	14 21	14 29	14 37	14 47	14 58	15 11	15 26	15 44	16 07
31	14 42	14 48	14 54	15 00	15 07	15 14	15 22	15 31	15 41	15 53	16 07	16 23	16 43	17 08
Sept. 1	15 31	15 36	15 42	15 48	15 55	16 02	16 10	16 19	16 29	16 41	16 54	17 10	17 29	17 54
2	16 15	16 20	16 26	16 32	16 38	16 45	16 52	17 01	17 10	17 21	17 33	17 47	18 04	18 26
3	16 57	17 01	17 06	17 11	17 17	17 23	17 29	17 36	17 44	17 53	18 04	18 16	18 30	18 47
4	17 35	17 39	17 43	17 47	17 51	17 56	18 01	18 07	18 13	18 20	18 29	18 38	18 49	19 01
5	18 11	18 13	18 16	18 19	18 22	18 26	18 30	18 34	18 38	18 43	18 49	18 56	19 03	19 12
6	18 45	18 46	18 48	18 50	18 52	18 54	18 56	18 58	19 01	19 04	19 07	19 11	19 15	19 20
7	19 18	19 18	19 19	19 19	19 20	19 20	19 21	19 21	19 22	19 23	19 23	19 24	19 26	19 27
8	19 51	19 50	19 50	19 49	19 48	19 47	19 46	19 44	19 43	19 42	19 40	19 38	19 36	19 34
9	20 26	20 24	20 22	20 20	20 17	20 15	20 12	20 09	20 06	20 02	19 58	19 53	19 48	19 42

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Aug. 16	14 15	14 20	14 25	14 30	14 36	14 43	14 50	14 58	15 07	15 18	15 29	15 43	16 00	16 21
17	15 20	15 25	15 31	15 37	15 43	15 51	15 59	16 08	16 18	16 29	16 43	16 58	17 17	17 42
18	16 20	16 26	16 31	16 37	16 44	16 51	16 59	17 08	17 19	17 30	17 43	17 59	18 18	18 42
19	17 15	17 20	17 25	17 31	17 37	17 43	17 51	17 59	18 08	18 18	18 30	18 44	19 01	19 21
20	18 03	18 07	18 12	18 16	18 21	18 27	18 33	18 40	18 47	18 56	19 05	19 16	19 29	19 45
21	18 45	18 48	18 52	18 55	18 59	19 03	19 08	19 13	19 19	19 25	19 32	19 40	19 49	20 00
22	19 23	19 25	19 27	19 29	19 32	19 35	19 38	19 41	19 44	19 48	19 53	19 58	20 03	20 10
23	19 57	19 58	19 59	20 00	20 01	20 02	20 04	20 05	20 07	20 08	20 10	20 12	20 15	20 18
24	20 29	20 29	20 29	20 28	20 28	20 28	20 28	20 27	20 27	20 27	20 26	20 26	20 25	20 25
25	21 00	20 59	20 57	20 56	20 54	20 53	20 51	20 49	20 47	20 44	20 42	20 39	20 35	20 31
26	21 31	21 29	21 27	21 24	21 21	21 18	21 15	21 11	21 07	21 03	20 58	20 52	20 46	20 38
27	22 04	22 01	21 57	21 54	21 50	21 45	21 40	21 35	21 29	21 23	21 16	21 08	20 58	20 47
28	22 39	22 35	22 30	22 26	22 20	22 15	22 09	22 02	21 55	21 47	21 37	21 26	21 14	20 58
29	23 16	23 12	23 07	23 01	22 55	22 49	22 42	22 34	22 25	22 15	22 03	21 50	21 34	21 15
30	23 58	23 53	23 47	23 41	23 35	23 27	23 20	23 11	23 01	22 50	22 37	22 22	22 03	21 40
31	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 55	23 44	23 33	23 19	23 03	22 43	22 18
Sept. 1	0 44	0 38	0 33	0 26	0 20	0 12	0 04	.. ..	.. ..	.. ..	.. ..	23 56	23 36	23 12
2	1 34	1 29	1 23	1 17	1 10	1 03	0 55	0 46	0 36	0 25	0 11	.. ..	.. ..	.. ..
3	2 28	2 24	2 18	2 13	2 07	2 00	1 53	1 45	1 36	1 25	1 13	0 59	0 42	0 21
4	3 26	3 22	3 18	3 13	3 08	3 02	2 56	2 49	2 41	2 33	2 23	2 11	1 58	1 41
5	4 27	4 24	4 20	4 17	4 13	4 08	4 03	3 58	3 52	3 46	3 38	3 30	3 20	3 08
6	5 30	5 27	5 25	5 23	5 20	5 17	5 14	5 10	5 06	5 02	4 57	4 52	4 45	4 38
7	6 34	6 33	6 31	6 30	6 29	6 28	6 26	6 25	6 23	6 21	6 19	6 16	6 13	6 10
8	7 39	7 39	7 39	7 40	7 40	7 40	7 40	7 41	7 41	7 41	7 42	7 42	7 43	7 43
9	8 45	8 47	8 48	8 50	8 52	8 54	8 56	8 58	9 00	9 03	9 06	9 10	9 14	9 19

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Sept. 8	20 22	20 18	20 16	20 13	20 12	20 10	20 07	20 04	20 02	20 00	19 57	19 54	19 53	19 51
9	21 41	21 33	21 26	21 20	21 16	21 12	21 05	20 58	20 53	20 47	20 41	20 34	20 30	20 26
10	23 00	22 47	22 37	22 28	22 21	22 15	22 04	21 54	21 45	21 36	21 27	21 16	21 10	21 03
11	.. ..	.. ..	23 47	23 36	23 26	23 18	23 04	22 51	22 39	22 28	22 16	22 02	21 54	21 44
12	0 18	0 01	.. ..	.. ..	.. ..	.. ..	.. ..	23 50	23 36	23 22	23 08	22 51	22 42	22 31
13	1 32	1 12	0 55	0 42	0 31	0 21	0 04	.. ..	.. ..	.. ..	.. ..	23 46	23 35	23 23
14	2 40	2 17	1 59	1 45	1 33	1 22	1 04	0 49	0 34	0 19	0 03	.. ..	.. ..	.. ..
15	3 37	3 15	2 57	2 43	2 31	2 21	2 03	1 47	1 32	1 17	1 02	0 44	0 33	0 21
16	4 24	4 04	3 48	3 35	3 24	3 15	2 58	2 43	2 30	2 16	2 02	1 45	1 35	1 24
17	5 02	4 45	4 32	4 21	4 12	4 04	3 50	3 37	3 26	3 14	3 02	2 47	2 39	2 30
18	5 32	5 20	5 10	5 02	4 55	4 49	4 38	4 28	4 19	4 10	4 01	3 50	3 44	3 36
19	5 58	5 50	5 44	5 38	5 34	5 30	5 23	5 16	5 10	5 05	4 58	4 51	4 47	4 42
20	6 21	6 17	6 14	6 12	6 10	6 08	6 05	6 02	5 59	5 57	5 54	5 51	5 49	5 47
21	6 42	6 42	6 43	6 44	6 44	6 45	6 45	6 46	6 47	6 48	6 48	6 49	6 50	6 50
22	7 02	7 07	7 11	7 15	7 18	7 20	7 25	7 29	7 33	7 37	7 41	7 46	7 49	7 52
23	7 24	7 33	7 40	7 46	7 52	7 56	8 05	8 12	8 19	8 26	8 33	8 41	8 46	8 52
24	7 47	8 00	8 11	8 19	8 27	8 33	8 45	8 55	9 04	9 14	9 24	9 36	9 43	9 50
25	8 14	8 30	8 44	8 54	9 04	9 12	9 26	9 39	9 50	10 02	10 15	10 29	10 38	10 47
26	8 45	9 05	9 20	9 33	9 43	9 53	10 09	10 24	10 37	10 50	11 05	11 21	11 31	11 42
27	9 22	9 44	10 01	10 15	10 26	10 37	10 54	11 10	11 24	11 39	11 54	12 12	12 22	12 34
28	10 07	10 29	10 46	11 01	11 13	11 23	11 41	11 57	12 12	12 27	12 43	13 01	13 11	13 24
29	10 59	11 20	11 37	11 51	12 03	12 13	12 31	12 46	13 00	13 15	13 30	13 48	13 58	14 09
30	11 58	12 17	12 33	12 45	12 56	13 05	13 21	13 36	13 49	14 02	14 16	14 32	14 41	14 52
Oct. 1	13 03	13 19	13 32	13 43	13 52	14 00	14 14	14 26	14 37	14 48	15 00	15 14	15 22	15 31
2	14 13	14 25	14 35	14 43	14 50	14 57	15 07	15 17	15 26	15 34	15 44	15 54	16 01	16 07

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Sept. 8	7 31	7 32	7 32	7 33	7 33	7 34	7 35	7 35	7 36	7 37	7 37	7 38	7 38	7 39
9	7 53	7 59	8 03	8 07	8 10	8 13	8 18	8 22	8 26	8 30	8 34	8 39	8 42	8 45
10	8 18	8 28	8 36	8 42	8 48	8 53	9 02	9 10	9 17	9 25	9 33	9 42	9 47	9 53
11	8 46	9 00	9 12	9 22	9 30	9 37	9 49	10 00	10 11	10 21	10 32	10 45	10 52	11 00
12	9 20	9 39	9 53	10 05	10 15	10 24	10 40	10 53	11 06	11 19	11 32	11 48	11 57	12 07
13	10 03	10 24	10 41	10 54	11 06	11 16	11 34	11 49	12 03	12 18	12 33	12 50	13 01	13 12
14	10 55	11 18	11 35	11 50	12 02	12 13	12 31	12 47	13 02	13 16	13 32	13 50	14 01	14 13
15	11 58	12 19	12 36	12 50	13 02	13 13	13 30	13 46	14 00	14 14	14 29	14 47	14 57	15 08
16	13 08	13 28	13 43	13 55	14 05	14 15	14 30	14 44	14 57	15 09	15 23	15 38	15 47	15 57
17	14 24	14 39	14 51	15 01	15 10	15 17	15 30	15 41	15 52	16 02	16 13	16 25	16 33	16 41
18	15 41	15 52	16 01	16 08	16 14	16 19	16 29	16 37	16 44	16 51	16 59	17 08	17 13	17 19
19	16 59	17 05	17 09	17 14	17 17	17 20	17 25	17 30	17 34	17 38	17 43	17 48	17 51	17 54
20	18 14	18 16	18 17	18 18	18 18	18 19	18 20	18 21	18 22	18 23	18 24	18 25	18 26	18 27
21	19 28	19 25	19 22	19 20	19 18	19 17	19 14	19 11	19 09	19 07	19 04	19 01	19 00	18 58
22	20 39	20 32	20 26	20 21	20 17	20 13	20 06	20 00	19 55	19 50	19 44	19 37	19 34	19 29
23	21 49	21 37	21 28	21 20	21 14	21 08	20 58	20 49	20 41	20 32	20 24	20 14	20 08	20 01
24	22 56	22 40	22 28	22 18	22 09	22 02	21 49	21 37	21 26	21 16	21 04	20 51	20 44	20 35
25	.. ..	23 41	23 26	23 14	23 04	22 55	22 39	22 25	22 13	22 00	21 47	21 31	21 22	21 12
26	0 00	.. ..	.. ..	.. ..	23 56	23 46	23 29	23 14	23 00	22 46	22 31	22 13	22 03	21 52
27	0 59	0 38	0 21	0 08	.. ..	.. ..	.. ..	.. ..	23 47	23 32	23 17	22 59	22 48	22 36
28	1 52	1 30	1 13	0 58	0 46	0 36	0 18	0 02	.. ..	.. ..	.. ..	23 47	23 36	23 24
29	2 39	2 17	2 00	1 46	1 34	1 24	1 06	0 50	0 35	0 21	0 05	.. ..	.. ..	.. ..
30	3 19	2 59	2 43	2 30	2 19	2 09	1 52	1 37	1 24	1 10	0 55	0 38	0 28	0 16
Oct. 1	3 53	3 36	3 22	3 11	3 01	2 52	2 37	2 24	2 12	2 00	1 46	1 31	1 22	1 12
2	4 22	4 09	3 57	3 48	3 40	3 33	3 21	3 10	3 00	2 50	2 39	2 27	2 20	2 11

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Sept. 8	19 51	19 50	19 50	19 49	19 48	19 47	19 46	19 44	19 43	19 42	19 40	19 38	19 36	19 34
9	20 26	20 24	20 22	20 20	20 17	20 15	20 12	20 09	20 06	20 02	19 58	19 53	19 48	19 42
10	21 03	21 00	20 57	20 53	20 50	20 46	20 41	20 36	20 31	20 25	20 18	20 11	20 02	19 51
11	21 44	21 40	21 36	21 31	21 26	21 21	21 15	21 08	21 01	20 53	20 44	20 33	20 20	20 05
12	22 31	22 26	22 21	22 15	22 09	22 03	21 55	21 47	21 38	21 28	21 17	21 03	20 47	20 27
13	23 23	23 18	23 12	23 06	22 59	22 52	22 44	22 35	22 25	22 14	22 00	21 45	21 26	21 02
14	.. ..	.. ..	.. ..	.. ..	23 57	23 50	23 42	23 33	23 23	23 11	22 57	22 42	22 22	21 57
15	0 21	0 16	0 10	0 04	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 53	23 35	23 14
16	1 24	1 19	1 14	1 08	1 02	0 55	0 48	0 39	0 30	0 19	0 07	.. ..	.. ..	.. ..
17	2 30	2 26	2 21	2 16	2 11	2 05	1 59	1 52	1 44	1 35	1 25	1 14	1 00	0 43
18	3 36	3 33	3 30	3 26	3 22	3 18	3 13	3 08	3 02	2 55	2 48	2 40	2 30	2 18
19	4 42	4 40	4 38	4 36	4 33	4 30	4 27	4 24	4 20	4 16	4 12	4 06	4 00	3 53
20	5 47	5 46	5 45	5 44	5 43	5 42	5 41	5 39	5 38	5 36	5 34	5 32	5 29	5 26
21	6 50	6 51	6 51	6 51	6 52	6 52	6 52	6 53	6 53	6 54	6 54	6 55	6 56	6 57
22	7 52	7 53	7 55	7 56	7 58	8 00	8 02	8 04	8 07	8 10	8 13	8 16	8 20	8 25
23	8 52	8 54	8 57	9 00	9 03	9 06	9 10	9 14	9 18	9 23	9 29	9 35	9 43	9 51
24	9 50	9 54	9 58	10 02	10 06	10 11	10 16	10 21	10 28	10 35	10 43	10 52	11 03	11 16
25	10 47	10 52	10 56	11 01	11 07	11 12	11 19	11 26	11 34	11 43	11 53	12 05	12 20	12 37
26	11 42	11 47	11 52	11 58	12 04	12 11	12 19	12 27	12 36	12 47	12 59	13 13	13 31	13 53
27	12 34	12 40	12 45	12 52	12 58	13 06	13 14	13 23	13 33	13 45	13 58	14 14	14 34	14 59
28	13 24	13 29	13 35	13 41	13 48	13 56	14 04	14 13	14 23	14 35	14 49	15 05	15 25	15 51
29	14 09	14 15	14 20	14 26	14 33	14 40	14 48	14 57	15 07	15 18	15 31	15 46	16 05	16 28
30	14 52	14 57	15 02	15 07	15 13	15 19	15 26	15 34	15 43	15 53	16 04	16 17	16 33	16 52
Oct. 1	15 31	15 35	15 39	15 44	15 49	15 54	16 00	16 07	16 14	16 22	16 31	16 42	16 54	17 09
2	16 07	16 11	16 14	16 17	16 21	16 25	16 30	16 35	16 40	16 46	16 53	17 01	17 10	17 20

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Sept. 8	7 39	7 39	7 39	7 40	7 40	7 40	7 40	7 41	7 41	7 41	7 42	7 42	7 43	7 43
9	8 45	8 47	8 48	8 50	8 52	8 54	8 56	8 58	9 00	9 03	9 06	9 10	9 14	9 19
10	9 53	9 55	9 58	10 01	10 04	10 08	10 12	10 16	10 21	10 26	10 32	10 38	10 46	10 55
11	11 00	11 04	11 08	11 12	11 17	11 22	11 27	11 34	11 40	11 48	11 57	12 07	12 18	12 33
12	12 07	12 12	12 17	12 22	12 28	12 34	12 41	12 49	12 58	13 07	13 19	13 32	13 47	14 07
13	13 12	13 18	13 23	13 29	13 36	13 43	13 51	14 00	14 09	14 21	14 34	14 49	15 08	15 31
14	14 13	14 18	14 24	14 30	14 37	14 45	14 53	15 02	15 12	15 24	15 37	15 53	16 13	16 38
15	15 08	15 13	15 19	15 25	15 31	15 38	15 46	15 55	16 04	16 15	16 28	16 42	17 00	17 22
16	15 57	16 02	16 07	16 12	16 17	16 23	16 30	16 37	16 46	16 55	17 05	17 18	17 32	17 49
17	16 41	16 44	16 48	16 52	16 57	17 01	17 07	17 12	17 19	17 26	17 34	17 43	17 54	18 07
18	17 19	17 22	17 24	17 27	17 30	17 34	17 37	17 41	17 46	17 51	17 56	18 03	18 10	18 18
19	17 54	17 55	17 57	17 59	18 00	18 02	18 04	18 06	18 09	18 12	18 15	18 18	18 22	18 26
20	18 27	18 27	18 27	18 28	18 28	18 28	18 29	18 29	18 30	18 30	18 31	18 32	18 32	18 33
21	18 58	18 57	18 56	18 55	18 54	18 53	18 52	18 51	18 50	18 48	18 46	18 44	18 42	18 40
22	19 29	19 27	19 25	19 23	19 21	19 19	19 16	19 13	19 10	19 06	19 02	18 57	18 52	18 46
23	20 01	19 59	19 56	19 52	19 49	19 45	19 41	19 36	19 31	19 25	19 19	19 12	19 04	18 54
24	20 35	20 32	20 28	20 23	20 19	20 14	20 08	20 02	19 55	19 48	19 39	19 29	19 17	19 04
25	21 12	21 08	21 03	20 57	20 52	20 46	20 39	20 31	20 23	20 14	20 03	19 50	19 36	19 18
26	21 52	21 47	21 42	21 36	21 29	21 22	21 15	21 06	20 57	20 46	20 33	20 18	20 01	19 39
27	22 36	22 31	22 25	22 19	22 12	22 04	21 56	21 47	21 37	21 25	21 11	20 55	20 36	20 11
28	23 24	23 19	23 13	23 07	23 00	22 52	22 44	22 35	22 25	22 13	21 59	21 43	21 23	20 57
29	.. ..	.. ..	.. ..	.. ..	23 54	23 47	23 39	23 30	23 20	23 09	22 57	22 42	22 23	22 00
30	0 16	0 11	0 06	0 00	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 50	23 35	23 16
Oct. 1	1 12	1 08	1 03	0 58	0 52	0 46	0 39	0 32	0 23	0 14	0 03	.. ..	.. ..	.. ..
2	2 11	2 08	2 04	2 00	1 55	1 50	1 45	1 39	1 32	1 24	1 16	1 06	0 54	0 40

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	13 03	13 19	13 32	13 43	13 52	14 00	14 14	14 26	14 37	14 48	15 00	15 14	15 22	15 31
2	14 13	14 25	14 35	14 43	14 50	14 57	15 07	15 17	15 26	15 34	15 44	15 54	16 01	16 07
3	15 26	15 34	15 41	15 46	15 51	15 55	16 02	16 08	16 14	16 20	16 26	16 33	16 37	16 42
4	16 43	16 46	16 49	16 51	16 53	16 55	16 58	17 01	17 03	17 06	17 09	17 12	17 14	17 16
5	18 02	18 00	17 59	17 58	17 57	17 57	17 55	17 54	17 53	17 52	17 51	17 50	17 50	17 49
6	19 22	19 16	19 11	19 06	19 03	19 00	18 54	18 49	18 45	18 40	18 36	18 30	18 27	18 24
7	20 44	20 33	20 24	20 16	20 10	20 04	19 54	19 46	19 38	19 30	19 22	19 12	19 07	19 01
8	22 05	21 49	21 36	21 26	21 17	21 09	20 56	20 44	20 33	20 22	20 11	19 58	19 50	19 42
9	23 23	23 03	22 47	22 35	22 24	22 14	21 58	21 44	21 30	21 17	21 03	20 47	20 38	20 27
10	.. ..	.. ..	23 54	23 40	23 28	23 17	22 59	22 43	22 29	22 14	21 59	21 41	21 30	21 19
11	0 34	0 12	.. ..	.. ..	.. ..	.. ..	23 59	23 43	23 28	23 13	22 57	22 38	22 28	22 15
12	1 35	1 12	0 55	0 40	0 28	0 17	.. ..	.. ..	.. ..	.. ..	23 56	23 39	23 28	23 17
13	2 25	2 04	1 47	1 34	1 22	1 12	0 55	0 39	0 25	0 11	.. ..	.. ..	.. ..	.. ..
14	3 04	2 47	2 32	2 21	2 11	2 02	1 47	1 33	1 21	1 09	0 55	0 40	0 31	0 21
15	3 36	3 22	3 11	3 02	2 54	2 47	2 35	2 24	2 14	2 04	1 54	1 41	1 34	1 26
16	4 02	3 53	3 45	3 39	3 33	3 28	3 20	3 12	3 05	2 58	2 50	2 42	2 37	2 31
17	4 25	4 20	4 16	4 12	4 09	4 06	4 02	3 58	3 54	3 50	3 46	3 41	3 38	3 35
18	4 46	4 45	4 44	4 44	4 43	4 43	4 42	4 41	4 41	4 40	4 39	4 39	4 38	4 38
19	5 06	5 09	5 12	5 14	5 16	5 18	5 21	5 24	5 27	5 29	5 32	5 35	5 37	5 39
20	5 26	5 34	5 40	5 45	5 50	5 54	6 00	6 06	6 12	6 18	6 24	6 31	6 35	6 40
21	5 49	6 00	6 10	6 17	6 24	6 30	6 40	6 49	6 58	7 06	7 16	7 26	7 32	7 39
22	6 14	6 29	6 41	6 51	7 00	7 08	7 21	7 33	7 44	7 55	8 07	8 20	8 28	8 37
23	6 43	7 01	7 16	7 28	7 39	7 48	8 04	8 17	8 30	8 43	8 57	9 13	9 23	9 33
24	7 17	7 39	7 55	8 09	8 20	8 30	8 48	9 03	9 17	9 32	9 47	10 05	10 15	10 27
25	7 59	8 21	8 39	8 53	9 05	9 16	9 34	9 50	10 05	10 20	10 36	10 54	11 05	11 17

MOONSET

	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	3 53	3 36	3 22	3 11	3 01	2 52	2 37	2 24	2 12	2 00	1 46	1 31	1 22	1 12
2	4 22	4 09	3 57	3 48	3 40	3 33	3 21	3 10	3 00	2 50	2 39	2 27	2 20	2 11
3	4 48	4 38	4 30	4 24	4 18	4 13	4 04	3 56	3 49	3 42	3 34	3 24	3 19	3 13
4	5 11	5 06	5 01	4 57	4 54	4 51	4 46	4 42	4 38	4 33	4 29	4 24	4 21	4 17
5	5 33	5 32	5 31	5 31	5 30	5 30	5 29	5 28	5 27	5 26	5 25	5 24	5 24	5 23
6	5 56	5 59	6 02	6 05	6 07	6 09	6 12	6 15	6 18	6 20	6 23	6 26	6 28	6 30
7	6 20	6 28	6 35	6 40	6 45	6 49	6 57	7 04	7 10	7 16	7 23	7 30	7 34	7 39
8	6 47	7 00	7 10	7 19	7 26	7 33	7 44	7 54	8 04	8 13	8 23	8 35	8 42	8 49
9	7 20	7 37	7 51	8 02	8 12	8 20	8 35	8 48	9 00	9 12	9 25	9 40	9 49	9 59
10	8 00	8 21	8 37	8 50	9 02	9 12	9 29	9 44	9 58	10 12	10 27	10 44	10 54	11 06
11	8 50	9 12	9 30	9 45	9 57	10 08	10 26	10 42	10 57	11 12	11 28	11 46	11 57	12 09
12	9 49	10 12	10 29	10 44	10 56	11 07	11 25	11 41	11 55	12 10	12 26	12 44	12 54	13 06
13	10 58	11 18	11 34	11 47	11 58	12 08	12 24	12 39	12 52	13 06	13 20	13 36	13 46	13 56
14	12 11	12 28	12 41	12 52	13 01	13 09	13 23	13 35	13 47	13 58	14 10	14 24	14 31	14 40
15	13 27	13 39	13 49	13 57	14 04	14 10	14 21	14 30	14 39	14 47	14 56	15 07	15 13	15 19
16	14 43	14 50	14 57	15 02	15 06	15 10	15 17	15 23	15 29	15 34	15 40	15 46	15 50	15 54
17	15 57	16 01	16 03	16 05	16 07	16 09	16 12	16 14	16 16	16 19	16 21	16 24	16 25	16 27
18	17 11	17 10	17 08	17 08	17 07	17 06	17 05	17 04	17 03	17 02	17 01	16 59	16 59	16 58
19	18 23	18 17	18 13	18 09	18 05	18 02	17 57	17 53	17 48	17 44	17 40	17 35	17 32	17 28
20	19 33	19 23	19 15	19 09	19 03	18 58	18 49	18 41	18 34	18 27	18 19	18 11	18 06	18 00
21	20 42	20 28	20 17	20 07	19 59	19 52	19 40	19 30	19 20	19 10	19 00	18 48	18 41	18 33
22	21 48	21 30	21 16	21 04	20 55	20 46	20 31	20 18	20 06	19 54	19 41	19 27	19 18	19 08
23	22 49	22 29	22 13	21 59	21 48	21 38	21 21	21 07	20 53	20 39	20 25	20 08	19 58	19 47
24	23 45	23 23	23 06	22 52	22 39	22 29	22 11	21 55	21 40	21 26	21 10	20 52	20 41	20 29
25	.. ..	.. ..	23 55	23 40	23 28	23 17	22 59	22 43	22 28	22 13	21 57	21 39	21 28	21 16

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	15 31	15 35	15 39	15 44	15 49	15 54	16 00	16 07	16 14	16 22	16 31	16 42	16 54	17 09
2	16 07	16 11	16 14	16 17	16 21	16 25	16 30	16 35	16 40	16 46	16 53	17 01	17 10	17 20
3	16 42	16 44	16 46	16 49	16 51	16 54	16 57	17 00	17 03	17 07	17 12	17 17	17 22	17 29
4	17 16	17 16	17 17	17 18	17 20	17 21	17 22	17 23	17 25	17 27	17 28	17 31	17 33	17 36
5	17 49	17 49	17 49	17 48	17 48	17 47	17 47	17 47	17 46	17 46	17 45	17 44	17 44	17 43
6	18 24	18 22	18 21	18 19	18 17	18 15	18 13	18 11	18 08	18 05	18 02	17 59	17 55	17 50
7	19 01	18 58	18 55	18 52	18 49	18 46	18 42	18 37	18 33	18 28	18 22	18 15	18 08	17 59
8	19 42	19 38	19 34	19 30	19 25	19 20	19 14	19 08	19 02	18 54	18 46	18 36	18 24	18 11
9	20 27	20 23	20 18	20 12	20 07	20 00	19 53	19 46	19 37	19 27	19 16	19 03	18 48	18 30
10	21 19	21 13	21 08	21 02	20 55	20 48	20 40	20 31	20 21	20 10	19 57	19 41	19 23	19 00
11	22 15	22 10	22 04	21 58	21 51	21 44	21 35	21 26	21 16	21 04	20 50	20 34	20 14	19 48
12	23 17	23 12	23 06	23 00	22 54	22 46	22 39	22 30	22 20	22 09	21 56	21 41	21 22	20 59
13	.. ..	.. ..	.. ..	.. ..	.. ..	23 55	23 48	23 40	23 32	23 22	23 11	22 59	22 43	22 25
14	0 21	0 16	0 12	0 06	0 01	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 57
15	1 26	1 23	1 19	1 15	1 10	1 05	1 00	0 54	0 48	0 40	0 32	0 22	0 11	.. ..
16	2 31	2 29	2 26	2 23	2 20	2 17	2 13	2 09	2 04	1 59	1 54	1 47	1 40	1 31
17	3 35	3 34	3 32	3 31	3 29	3 27	3 25	3 23	3 21	3 18	3 15	3 12	3 08	3 03
18	4 38	4 38	4 38	4 37	4 37	4 37	4 37	4 36	4 36	4 36	4 35	4 35	4 34	4 34
19	5 39	5 40	5 41	5 43	5 44	5 45	5 46	5 48	5 50	5 52	5 54	5 56	5 59	6 02
20	6 40	6 42	6 44	6 47	6 49	6 52	6 55	6 58	7 02	7 06	7 11	7 16	7 22	7 29
21	7 39	7 42	7 46	7 49	7 53	7 57	8 02	8 07	8 12	8 19	8 26	8 34	8 44	8 55
22	8 37	8 41	8 45	8 50	8 55	9 01	9 07	9 13	9 21	9 29	9 39	9 50	10 03	10 19
23	9 33	9 38	9 43	9 49	9 55	10 01	10 08	10 16	10 25	10 35	10 47	11 01	11 17	11 38
24	10 27	10 32	10 38	10 44	10 51	10 58	11 06	11 15	11 25	11 36	11 50	12 06	12 25	12 49
25	11 17	11 23	11 29	11 35	11 42	11 50	11 58	12 08	12 18	12 30	12 44	13 01	13 22	13 48

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	1 12	1 08	1 03	0 58	0 52	0 46	0 39	0 32	0 23	0 14	0 03	.. ..	.. ..	.. ..
2	2 11	2 08	2 04	2 00	1 55	1 50	1 45	1 39	1 32	1 24	1 16	1 06	0 54	0 40
3	3 13	3 11	3 08	3 05	3 01	2 58	2 54	2 49	2 45	2 39	2 33	2 26	2 18	2 09
4	4 17	4 16	4 14	4 12	4 10	4 08	4 06	4 04	4 01	3 58	3 54	3 50	3 46	3 41
5	5 23	5 23	5 22	5 22	5 21	5 21	5 21	5 20	5 19	5 19	5 18	5 17	5 16	5 15
6	6 30	6 31	6 32	6 33	6 35	6 36	6 37	6 39	6 40	6 42	6 44	6 47	6 49	6 52
7	7 39	7 42	7 44	7 46	7 49	7 52	7 55	7 59	8 03	8 07	8 12	8 18	8 24	8 32
8	8 49	8 53	8 56	9 00	9 04	9 09	9 14	9 19	9 25	9 32	9 40	9 49	10 00	10 12
9	9 59	10 03	10 08	10 13	10 18	10 24	10 31	10 38	10 46	10 56	11 06	11 19	11 33	11 51
10	11 06	11 11	11 17	11 22	11 29	11 36	11 44	11 52	12 02	12 13	12 26	12 41	12 59	13 22
11	12 09	12 14	12 20	12 26	12 33	12 41	12 49	12 58	13 09	13 20	13 34	13 51	14 10	14 36
12	13 06	13 11	13 17	13 23	13 30	13 37	13 45	13 54	14 04	14 15	14 28	14 44	15 03	15 26
13	13 56	14 01	14 06	14 12	14 18	14 24	14 31	14 39	14 48	14 58	15 09	15 22	15 38	15 57
14	14 40	14 44	14 49	14 53	14 58	15 03	15 09	15 15	15 22	15 30	15 39	15 50	16 02	16 16
15	15 19	15 22	15 25	15 29	15 32	15 36	15 41	15 45	15 50	15 56	16 03	16 10	16 18	16 28
16	15 54	15 56	15 58	16 00	16 03	16 05	16 08	16 11	16 14	16 17	16 21	16 26	16 31	16 37
17	16 27	16 27	16 28	16 29	16 30	16 31	16 32	16 33	16 34	16 36	16 37	16 39	16 41	16 43
18	16 58	16 57	16 57	16 57	16 56	16 56	16 55	16 55	16 54	16 53	16 52	16 51	16 50	16 49
19	17 28	17 27	17 25	17 24	17 22	17 20	17 18	17 16	17 13	17 10	17 07	17 04	17 00	16 55
20	18 00	17 57	17 55	17 52	17 49	17 46	17 42	17 38	17 34	17 29	17 23	17 17	17 10	17 02
21	18 33	18 29	18 26	18 22	18 18	18 13	18 08	18 02	17 56	17 49	17 41	17 33	17 22	17 10
22	19 08	19 04	18 59	18 55	18 49	18 43	18 37	18 30	18 22	18 13	18 03	17 52	17 38	17 22
23	19 47	19 42	19 37	19 31	19 25	19 18	19 11	19 02	18 53	18 43	18 31	18 16	18 00	17 39
24	20 29	20 24	20 18	20 12	20 05	19 58	19 50	19 41	19 30	19 19	19 05	18 49	18 30	18 05
25	21 16	21 10	21 04	20 58	20 51	20 43	20 35	20 26	20 15	20 03	19 49	19 32	19 11	18 45

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 24	7 17	7 39	7 55	8 09	8 20	8 30	8 48	9 03	9 17	9 32	9 47	10 05	10 15	10 27
25	7 59	8 21	8 39	8 53	9 05	9 16	9 34	9 50	10 05	10 20	10 36	10 54	11 05	11 17
26	8 47	9 10	9 27	9 41	9 53	10 04	10 22	10 38	10 53	11 08	11 24	11 42	11 52	12 04
27	9 43	10 04	10 20	10 33	10 45	10 55	11 12	11 27	11 41	11 55	12 09	12 27	12 36	12 48
28	10 44	11 03	11 17	11 29	11 39	11 48	12 03	12 16	12 28	12 41	12 54	13 09	13 18	13 27
29	11 51	12 06	12 17	12 27	12 35	12 42	12 55	13 06	13 16	13 26	13 37	13 49	13 56	14 04
30	13 02	13 13	13 21	13 28	13 34	13 39	13 48	13 56	14 03	14 11	14 19	14 28	14 33	14 39
31	14 16	14 22	14 27	14 31	14 34	14 37	14 43	14 47	14 51	14 56	15 00	15 05	15 08	15 12
Nov. 1	15 34	15 35	15 36	15 36	15 37	15 38	15 39	15 40	15 40	15 41	15 42	15 43	15 44	15 45
2	16 54	16 50	16 47	16 44	16 42	16 40	16 37	16 34	16 31	16 28	16 26	16 22	16 21	16 19
3	18 17	18 08	18 01	17 55	17 49	17 45	17 37	17 30	17 24	17 18	17 11	17 04	16 59	16 55
4	19 41	19 27	19 16	19 06	18 59	18 52	18 40	18 29	18 20	18 10	18 00	17 48	17 42	17 34
5	21 04	20 45	20 31	20 18	20 08	19 59	19 44	19 30	19 18	19 05	18 52	18 37	18 29	18 19
6	22 22	21 59	21 42	21 28	21 16	21 06	20 48	20 33	20 18	20 04	19 49	19 31	19 21	19 09
7	23 29	23 06	22 48	22 33	22 20	22 09	21 51	21 34	21 19	21 04	20 48	20 29	20 18	20 06
8	.. ..	.. ..	23 45	23 31	23 19	23 08	22 50	22 34	22 19	22 04	21 49	21 31	21 20	21 08
9	0 24	0 02	.. ..	.. ..	.. ..	.. ..	23 44	23 30	23 17	23 04	22 50	22 33	22 24	22 13
10	1 08	0 49	0 33	0 21	0 10	0 01	.. ..	.. ..	.. ..	.. ..	23 49	23 36	23 28	23 19
11	1 42	1 26	1 14	1 04	0 55	0 48	0 34	0 23	0 12	0 01	.. ..	.. ..	.. ..	.. ..
12	2 09	1 58	1 49	1 42	1 35	1 30	1 20	1 11	1 03	0 55	0 46	0 36	0 31	0 24
13	2 32	2 26	2 20	2 16	2 12	2 08	2 02	1 57	1 52	1 47	1 42	1 35	1 32	1 28
14	2 53	2 50	2 49	2 47	2 46	2 44	2 42	2 40	2 39	2 37	2 35	2 33	2 32	2 30
15	3 12	3 14	3 16	3 17	3 18	3 19	3 21	3 22	3 24	3 25	3 27	3 29	3 30	3 31
16	3 32	3 38	3 43	3 47	3 51	3 54	3 59	4 04	4 09	4 13	4 18	4 24	4 28	4 31
17	3 53	4 03	4 11	4 18	4 24	4 29	4 38	4 46	4 54	5 01	5 09	5 19	5 24	5 30

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 24	23 45	23 23	23 06	22 52	22 39	22 29	22 11	21 55	21 40	21 26	21 10	20 52	20 41	20 29
25	.. ..	.. ..	23 55	23 40	23 28	23 17	22 59	22 43	22 28	22 13	21 57	21 39	21 28	21 16
26	0 35	0 12	.. ..	.. ..	.. ..	.. ..	23 46	23 30	23 16	23 01	22 46	22 28	22 18	22 06
27	1 17	0 56	0 39	0 25	0 14	0 03	.. ..	.. ..	.. ..	23 50	23 36	23 20	23 10	23 00
28	1 53	1 34	1 19	1 07	0 56	0 47	0 31	0 17	0 04	.. ..	.. ..	.. ..	.. ..	23 56
29	2 24	2 08	1 55	1 45	1 36	1 28	1 14	1 02	0 51	0 40	0 28	0 14	0 06	.. ..
30	2 50	2 38	2 28	2 20	2 13	2 07	1 57	1 47	1 39	1 30	1 20	1 09	1 03	0 56
31	3 13	3 05	2 59	2 54	2 49	2 45	2 38	2 32	2 26	2 20	2 14	2 07	2 03	1 58
Nov. 1	3 35	3 32	3 29	3 27	3 25	3 23	3 20	3 17	3 15	3 12	3 09	3 06	3 04	3 02
2	3 57	3 58	3 59	4 00	4 01	4 01	4 02	4 03	4 04	4 05	4 06	4 07	4 08	4 09
3	4 20	4 26	4 30	4 35	4 38	4 41	4 47	4 51	4 56	5 00	5 05	5 11	5 14	5 17
4	4 45	4 56	5 05	5 12	5 18	5 24	5 34	5 42	5 50	5 58	6 07	6 16	6 22	6 29
5	5 16	5 31	5 44	5 54	6 03	6 11	6 24	6 36	6 47	6 58	7 10	7 24	7 32	7 41
6	5 53	6 13	6 28	6 41	6 52	7 02	7 18	7 33	7 46	8 00	8 14	8 31	8 41	8 52
7	6 40	7 03	7 21	7 35	7 47	7 58	8 16	8 32	8 47	9 02	9 18	9 36	9 47	9 59
8	7 38	8 02	8 20	8 35	8 47	8 58	9 17	9 33	9 48	10 03	10 19	10 38	10 48	11 01
9	8 46	9 08	9 24	9 38	9 50	10 00	10 18	10 33	10 47	11 01	11 16	11 33	11 43	11 55
10	10 00	10 18	10 32	10 44	10 54	11 03	11 18	11 31	11 43	11 56	12 09	12 23	12 32	12 42
11	11 16	11 30	11 41	11 50	11 58	12 05	12 17	12 27	12 37	12 46	12 56	13 08	13 14	13 22
12	12 31	12 41	12 48	12 55	13 00	13 05	13 13	13 20	13 27	13 33	13 40	13 48	13 53	13 58
13	13 46	13 51	13 55	13 58	14 01	14 03	14 07	14 11	14 14	14 18	14 21	14 25	14 28	14 30
14	14 59	14 59	15 00	15 00	15 00	15 00	15 00	15 00	15 00	15 01	15 01	15 01	15 01	15 01
15	16 11	16 06	16 03	16 00	15 58	15 56	15 52	15 49	15 46	15 42	15 39	15 35	15 33	15 31
16	17 21	17 12	17 06	17 00	16 55	16 51	16 43	16 37	16 30	16 24	16 18	16 10	16 06	16 01
17	18 30	18 17	18 07	17 59	17 51	17 45	17 34	17 24	17 16	17 07	16 57	16 46	16 40	16 33

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 24	10 27	10 32	10 38	10 44	10 51	10 58	11 06	11 15	11 25	11 36	11 50	12 06	12 25	12 49
25	11 17	11 23	11 29	11 35	11 42	11 50	11 58	12 08	12 18	12 30	12 44	13 01	13 22	13 48
26	12 04	12 10	12 16	12 22	12 29	12 36	12 44	12 54	13 04	13 16	13 29	13 46	14 05	14 31
27	12 48	12 53	12 58	13 04	13 10	13 17	13 25	13 33	13 43	13 53	14 06	14 20	14 37	14 59
28	13 27	13 32	13 37	13 42	13 47	13 53	14 00	14 07	14 15	14 24	14 34	14 46	15 00	15 17
29	14 04	14 08	14 11	14 16	14 20	14 25	14 30	14 36	14 42	14 49	14 57	15 06	15 17	15 30
30	14 39	14 41	14 44	14 47	14 50	14 53	14 57	15 01	15 06	15 11	15 16	15 23	15 30	15 39
31	15 12	15 13	15 15	15 17	15 18	15 20	15 22	15 25	15 27	15 30	15 33	15 37	15 41	15 46
Nov. 1	15 45	15 45	15 45	15 46	15 46	15 47	15 47	15 48	15 48	15 49	15 49	15 50	15 51	15 52
2	16 19	16 18	16 17	16 16	16 15	16 13	16 12	16 11	16 09	16 08	16 06	16 04	16 01	15 58
3	16 55	16 52	16 50	16 48	16 45	16 42	16 39	16 36	16 32	16 28	16 24	16 19	16 13	16 06
4	17 34	17 31	17 27	17 24	17 20	17 15	17 10	17 05	16 59	16 53	16 45	16 37	16 27	16 16
5	18 19	18 14	18 10	18 05	17 59	17 53	17 47	17 40	17 32	17 23	17 13	17 01	16 47	16 31
6	19 09	19 04	18 59	18 53	18 46	18 39	18 32	18 23	18 13	18 02	17 50	17 35	17 17	16 55
7	20 06	20 01	19 55	19 48	19 41	19 34	19 25	19 16	19 06	18 54	18 40	18 23	18 03	17 37
8	21 08	21 03	20 57	20 50	20 44	20 36	20 28	20 19	20 09	19 57	19 43	19 27	19 07	18 42
9	22 13	22 08	22 03	21 57	21 51	21 45	21 37	21 29	21 20	21 10	20 58	20 44	20 27	20 06
10	23 19	23 15	23 11	23 06	23 01	22 56	22 50	22 43	22 36	22 28	22 18	22 08	21 55	21 39
11	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 58	23 53	23 47	23 41	23 33	23 24	23 14
12	0 24	0 21	0 18	0 15	0 11	0 07	0 03	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
13	1 28	1 26	1 24	1 22	1 20	1 18	1 15	1 12	1 09	1 06	1 02	0 57	0 52	0 46
14	2 30	2 30	2 29	2 28	2 28	2 27	2 26	2 25	2 24	2 23	2 21	2 20	2 18	2 16
15	3 31	3 32	3 32	3 33	3 34	3 34	3 35	3 36	3 37	3 38	3 39	3 41	3 42	3 44
16	4 31	4 33	4 35	4 37	4 39	4 41	4 43	4 46	4 49	4 52	4 56	5 00	5 05	5 11
17	5 30	5 33	5 36	5 39	5 43	5 46	5 50	5 55	6 00	6 05	6 11	6 19	6 27	6 37

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 24	20 29	20 24	20 18	20 12	20 05	19 58	19 50	19 41	19 30	19 19	19 05	18 49	18 30	18 05
25	21 16	21 10	21 04	20 58	20 51	20 43	20 35	20 26	20 15	20 03	19 49	19 32	19 11	18 45
26	22 06	22 00	21 55	21 49	21 42	21 35	21 26	21 17	21 07	20 55	20 42	20 26	20 06	19 41
27	23 00	22 55	22 49	22 44	22 38	22 31	22 24	22 16	22 06	21 56	21 44	21 30	21 13	20 52
28	23 56	23 52	23 48	23 43	23 38	23 32	23 26	23 19	23 12	23 03	22 53	22 42	22 28	22 12
29	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 59	23 49	23 37
30	0 56	0 53	0 49	0 46	0 42	0 37	0 33	0 27	0 22	0 15	0 08	.. ..	.. ..	.. ..
31	1 58	1 56	1 53	1 51	1 48	1 45	1 42	1 39	1 35	1 31	1 26	1 21	1 14	1 07
Nov. 1	3 02	3 01	3 00	2 59	2 58	2 56	2 55	2 54	2 52	2 50	2 48	2 45	2 43	2 40
2	4 09	4 09	4 09	4 09	4 10	4 10	4 11	4 11	4 12	4 12	4 13	4 14	4 14	4 15
3	5 17	5 19	5 21	5 23	5 25	5 27	5 29	5 31	5 34	5 37	5 41	5 45	5 49	5 55
4	6 29	6 31	6 34	6 38	6 41	6 45	6 49	6 54	6 59	7 05	7 11	7 19	7 27	7 38
5	7 41	7 45	7 49	7 54	7 59	8 04	8 10	8 17	8 24	8 32	8 42	8 53	9 06	9 22
6	8 52	8 57	9 02	9 08	9 14	9 21	9 28	9 36	9 46	9 56	10 08	10 23	10 40	11 02
7	9 59	10 05	10 11	10 17	10 24	10 31	10 40	10 49	10 59	11 11	11 25	11 41	12 01	12 27
8	11 01	11 06	11 12	11 18	11 25	11 33	11 41	11 50	12 01	12 13	12 27	12 43	13 03	13 28
9	11 55	12 00	12 05	12 11	12 17	12 24	12 32	12 40	12 50	13 00	13 13	13 27	13 44	14 06
10	12 42	12 46	12 50	12 55	13 01	13 06	13 13	13 20	13 27	13 36	13 46	13 58	14 11	14 27
11	13 22	13 25	13 29	13 33	13 37	13 41	13 46	13 51	13 57	14 04	14 11	14 19	14 29	14 41
12	13 58	14 00	14 02	14 05	14 08	14 11	14 14	14 17	14 21	14 26	14 30	14 36	14 42	14 49
13	14 30	14 31	14 33	14 34	14 35	14 37	14 38	14 40	14 42	14 44	14 47	14 49	14 52	14 56
14	15 01	15 01	15 01	15 01	15 01	15 01	15 01	15 01	15 01	15 01	15 01	15 01	15 01	15 01
15	15 31	15 30	15 29	15 27	15 26	15 25	15 23	15 21	15 20	15 18	15 15	15 13	15 10	15 06
16	16 01	15 59	15 57	15 54	15 52	15 49	15 46	15 43	15 39	15 35	15 30	15 25	15 19	15 12
17	16 33	16 30	16 27	16 23	16 19	16 15	16 10	16 05	16 00	15 54	15 47	15 39	15 30	15 19

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Nov. 16	3 32	3 38	3 43	3 47	3 51	3 54	3 59	4 04	4 09	4 13	4 18	4 24	4 28	4 31
17	3 53	4 03	4 11	4 18	4 24	4 29	4 38	4 46	4 54	5 01	5 09	5 19	5 24	5 30
18	4 16	4 30	4 41	4 51	4 59	5 06	5 18	5 29	5 39	5 49	6 00	6 13	6 20	6 29
19	4 43	5 01	5 15	5 26	5 36	5 45	6 00	6 13	6 25	6 38	6 51	7 06	7 15	7 26
20	5 15	5 36	5 52	6 05	6 16	6 26	6 43	6 58	7 12	7 26	7 41	7 59	8 09	8 20
21	5 54	6 16	6 34	6 48	7 00	7 11	7 29	7 45	8 00	8 15	8 31	8 49	9 00	9 12
22	6 39	7 02	7 20	7 35	7 47	7 58	8 16	8 33	8 48	9 03	9 19	9 38	9 49	10 01
23	7 32	7 54	8 11	8 25	8 37	8 47	9 05	9 21	9 35	9 50	10 05	10 23	10 34	10 46
24	8 31	8 51	9 06	9 19	9 30	9 39	9 55	10 09	10 23	10 36	10 50	11 06	11 15	11 26
25	9 35	9 51	10 04	10 15	10 24	10 32	10 46	10 58	11 09	11 21	11 33	11 46	11 54	12 03
26	10 43	10 55	11 05	11 13	11 21	11 27	11 38	11 47	11 56	12 05	12 14	12 25	12 31	12 38
27	11 54	12 02	12 08	12 14	12 19	12 23	12 30	12 36	12 42	12 48	12 54	13 01	13 06	13 10
28	13 07	13 11	13 14	13 16	13 18	13 20	13 24	13 26	13 29	13 32	13 35	13 38	13 40	13 42
29	14 24	14 23	14 22	14 21	14 21	14 20	14 19	14 18	14 17	14 17	14 16	14 15	14 15	14 14
30	15 44	15 38	15 33	15 29	15 25	15 22	15 17	15 12	15 08	15 04	14 59	14 54	14 51	14 48
Dec. 1	17 07	16 56	16 47	16 39	16 33	16 27	16 18	16 09	16 01	15 54	15 45	15 36	15 31	15 25
2	18 32	18 16	18 03	17 52	17 43	17 35	17 21	17 09	16 58	16 47	16 36	16 22	16 15	16 06
3	19 55	19 34	19 18	19 05	18 54	18 44	18 27	18 12	17 59	17 45	17 31	17 14	17 05	16 54
4	21 11	20 48	20 29	20 15	20 02	19 51	19 33	19 16	19 01	18 46	18 30	18 12	18 01	17 49
5	22 15	21 52	21 33	21 19	21 06	20 55	20 36	20 20	20 04	19 49	19 33	19 14	19 03	18 51
6	23 06	22 45	22 28	22 14	22 03	21 53	21 35	21 20	21 06	20 52	20 37	20 19	20 09	19 57
7	23 45	23 27	23 14	23 02	22 53	22 44	22 29	22 16	22 04	21 52	21 39	21 24	21 16	21 06
8	.. ..	.. ..	23 52	23 43	23 36	23 29	23 18	23 08	22 59	22 49	22 39	22 28	22 21	22 14
9	0 15	0 02	.. ..	.. ..	.. ..	.. ..	.. ..	23 56	23 50	23 43	23 37	23 29	23 25	23 20
10	0 40	0 31	0 25	0 19	0 14	0 10	0 02	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Nov. 16	17 21	17 12	17 06	17 00	16 55	16 51	16 43	16 37	16 30	16 24	16 18	16 10	16 06	16 01
17	18 30	18 17	18 07	17 59	17 51	17 45	17 34	17 24	17 16	17 07	16 57	16 46	16 40	16 33
18	19 37	19 20	19 07	18 56	18 47	18 39	18 25	18 13	18 01	17 50	17 38	17 24	17 16	17 07
19	20 40	20 21	20 05	19 52	19 41	19 32	19 16	19 01	18 48	18 35	18 21	18 04	17 55	17 44
20	21 39	21 17	21 00	20 46	20 34	20 23	20 05	19 50	19 35	19 21	19 05	18 47	18 37	18 25
21	22 32	22 09	21 51	21 36	21 24	21 13	20 54	20 38	20 23	20 08	19 52	19 33	19 22	19 10
22	23 17	22 54	22 37	22 23	22 11	22 00	21 42	21 26	21 11	20 56	20 40	20 21	20 11	19 58
23	23 55	23 35	23 18	23 05	22 54	22 44	22 27	22 12	21 58	21 44	21 29	21 12	21 02	20 50
24	.. ..	.. ..	23 55	23 44	23 34	23 26	23 11	22 58	22 45	22 33	22 20	22 04	21 56	21 45
25	0 27	0 09	.. ..	.. ..	.. ..	.. ..	23 52	23 42	23 32	23 22	23 11	22 58	22 51	22 43
26	0 54	0 40	0 29	0 20	0 12	0 05	.. ..	.. ..	.. ..	.. ..	.. ..	23 53	23 48	23 42
27	1 17	1 07	0 59	0 53	0 47	0 42	0 33	0 25	0 18	0 11	0 03	.. ..	.. ..	.. ..
28	1 39	1 33	1 29	1 25	1 21	1 18	1 13	1 09	1 04	1 00	0 55	0 50	0 47	0 43
29	1 59	1 58	1 57	1 56	1 56	1 55	1 54	1 53	1 52	1 51	1 50	1 49	1 48	1 47
30	2 20	2 24	2 27	2 29	2 31	2 33	2 36	2 39	2 41	2 44	2 46	2 49	2 51	2 53
Dec. 1	2 44	2 52	2 58	3 04	3 09	3 13	3 20	3 27	3 33	3 39	3 46	3 53	3 57	4 02
2	3 11	3 24	3 34	3 43	3 50	3 57	4 08	4 19	4 28	4 38	4 48	4 59	5 06	5 14
3	3 44	4 02	4 16	4 27	4 37	4 46	5 01	5 14	5 27	5 39	5 52	6 08	6 16	6 27
4	4 26	4 48	5 05	5 19	5 30	5 41	5 58	6 14	6 28	6 43	6 58	7 16	7 26	7 38
5	5 20	5 44	6 02	6 17	6 30	6 41	7 00	7 16	7 31	7 47	8 03	8 22	8 33	8 45
6	6 26	6 49	7 07	7 22	7 34	7 45	8 03	8 19	8 34	8 49	9 05	9 23	9 33	9 46
7	7 41	8 01	8 17	8 30	8 41	8 50	9 07	9 21	9 34	9 47	10 02	10 18	10 27	10 37
8	8 59	9 15	9 28	9 38	9 47	9 55	10 08	10 20	10 31	10 41	10 53	11 06	11 13	11 22
9	10 18	10 29	10 38	10 45	10 52	10 57	11 07	11 16	11 23	11 31	11 39	11 49	11 54	12 00
10	11 34	11 41	11 46	11 50	11 54	11 58	12 03	12 08	12 13	12 17	12 22	12 27	12 31	12 34

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Nov. 16	4 31	4 33	4 35	4 37	4 39	4 41	4 43	4 46	4 49	4 52	4 56	5 00	5 05	5 11
17	5 30	5 33	5 36	5 39	5 43	5 46	5 50	5 55	6 00	6 05	6 11	6 19	6 27	6 37
18	6 29	6 32	6 36	6 41	6 45	6 50	6 56	7 02	7 09	7 16	7 25	7 35	7 47	8 01
19	7 26	7 30	7 35	7 40	7 46	7 52	7 59	8 07	8 15	8 25	8 36	8 49	9 04	9 23
20	8 20	8 26	8 31	8 37	8 44	8 51	8 59	9 07	9 17	9 28	9 41	9 57	10 16	10 39
21	9 12	9 18	9 24	9 30	9 37	9 45	9 53	10 03	10 13	10 26	10 40	10 57	11 17	11 44
22	10 01	10 07	10 13	10 19	10 26	10 34	10 42	10 52	11 02	11 14	11 29	11 46	12 06	12 33
23	10 46	10 51	10 57	11 03	11 09	11 17	11 25	11 33	11 43	11 55	12 08	12 24	12 43	13 06
24	11 26	11 31	11 36	11 41	11 47	11 54	12 01	12 09	12 18	12 28	12 39	12 52	13 08	13 27
25	12 03	12 07	12 12	12 16	12 21	12 26	12 32	12 39	12 46	12 54	13 03	13 14	13 26	13 41
26	12 38	12 41	12 44	12 48	12 51	12 55	13 00	13 05	13 10	13 16	13 23	13 31	13 40	13 50
27	13 10	13 12	13 14	13 17	13 19	13 22	13 25	13 28	13 32	13 36	13 40	13 45	13 51	13 57
28	13 42	13 43	13 44	13 45	13 46	13 47	13 49	13 50	13 52	13 53	13 55	13 58	14 00	14 03
29	14 14	14 14	14 13	14 13	14 13	14 13	14 12	14 12	14 12	14 11	14 11	14 10	14 09	14 09
30	14 48	14 46	14 45	14 43	14 41	14 39	14 37	14 35	14 33	14 30	14 27	14 23	14 19	14 15
Dec. 1	15 25	15 22	15 19	15 16	15 13	15 09	15 05	15 01	14 57	14 51	14 46	14 39	14 32	14 23
2	16 06	16 02	15 58	15 54	15 49	15 44	15 38	15 32	15 25	15 18	15 09	14 59	14 48	14 34
3	16 54	16 49	16 44	16 39	16 33	16 26	16 19	16 11	16 02	15 52	15 41	15 27	15 12	14 52
4	17 49	17 44	17 38	17 31	17 25	17 17	17 09	17 00	16 49	16 38	16 24	16 08	15 49	15 24
5	18 51	18 45	18 39	18 33	18 26	18 18	18 09	18 00	17 49	17 37	17 23	17 06	16 45	16 18
6	19 57	19 52	19 47	19 40	19 34	19 27	19 19	19 10	19 00	18 49	18 36	18 21	18 02	17 38
7	21 06	21 01	20 57	20 52	20 46	20 40	20 33	20 26	20 18	20 09	19 58	19 46	19 31	19 13
8	22 14	22 10	22 07	22 03	21 59	21 54	21 49	21 44	21 38	21 31	21 23	21 14	21 04	20 51
9	23 20	23 18	23 15	23 13	23 10	23 07	23 04	23 00	22 56	22 52	22 47	22 41	22 35	22 27
10	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Nov. 16	16 01	15 59	15 57	15 54	15 52	15 49	15 46	15 43	15 39	15 35	15 30	15 25	15 19	15 12
17	16 33	16 30	16 27	16 23	16 19	16 15	16 10	16 05	16 00	15 54	15 47	15 39	15 30	15 19
18	17 07	17 03	16 59	16 54	16 49	16 44	16 38	16 31	16 24	16 16	16 06	15 56	15 43	15 28
19	17 44	17 39	17 34	17 29	17 23	17 16	17 09	17 01	16 52	16 42	16 31	16 18	16 02	15 42
20	18 25	18 20	18 14	18 08	18 01	17 54	17 46	17 37	17 27	17 15	17 02	16 47	16 28	16 04
21	19 10	19 04	18 58	18 52	18 45	18 37	18 29	18 19	18 08	17 56	17 42	17 25	17 04	16 37
22	19 58	19 53	19 47	19 41	19 34	19 26	19 18	19 08	18 58	18 45	18 31	18 14	17 54	17 27
23	20 50	20 45	20 40	20 34	20 27	20 20	20 12	20 04	19 54	19 43	19 30	19 14	18 56	18 32
24	21 45	21 41	21 36	21 31	21 25	21 19	21 12	21 05	20 56	20 47	20 36	20 23	20 08	19 49
25	22 43	22 39	22 35	22 31	22 26	22 21	22 16	22 10	22 03	21 56	21 47	21 37	21 25	21 11
26	23 42	23 39	23 37	23 34	23 30	23 27	23 23	23 18	23 14	23 08	23 02	22 55	22 47	22 38
27	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
28	0 43	0 42	0 40	0 38	0 36	0 34	0 32	0 30	0 27	0 24	0 20	0 16	0 12	0 06
29	1 47	1 47	1 46	1 46	1 45	1 45	1 44	1 44	1 43	1 42	1 41	1 41	1 39	1 38
30	2 53	2 54	2 55	2 56	2 57	2 58	2 59	3 01	3 02	3 04	3 06	3 08	3 11	3 14
Dec. 1	4 02	4 04	4 07	4 09	4 12	4 15	4 18	4 21	4 25	4 29	4 34	4 40	4 46	4 54
2	5 14	5 17	5 21	5 25	5 29	5 33	5 39	5 44	5 50	5 57	6 05	6 14	6 25	6 38
3	6 27	6 31	6 36	6 41	6 47	6 53	7 00	7 07	7 16	7 25	7 36	7 49	8 04	8 23
4	7 38	7 43	7 49	7 55	8 02	8 09	8 17	8 26	8 36	8 48	9 01	9 17	9 36	10 01
5	8 45	8 51	8 57	9 04	9 11	9 18	9 27	9 36	9 47	9 59	10 14	10 30	10 51	11 18
6	9 46	9 51	9 57	10 03	10 10	10 17	10 25	10 34	10 44	10 56	11 09	11 25	11 44	12 08
7	10 37	10 42	10 47	10 53	10 58	11 05	11 12	11 20	11 28	11 38	11 49	12 02	12 17	12 36
8	11 22	11 26	11 30	11 34	11 38	11 44	11 49	11 55	12 02	12 09	12 18	12 27	12 39	12 52
9	12 00	12 03	12 06	12 09	12 12	12 15	12 19	12 24	12 28	12 33	12 39	12 46	12 53	13 02
10	12 34	12 36	12 37	12 39	12 41	12 43	12 45	12 48	12 50	12 53	12 56	13 00	13 04	13 09

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Dec. 9	0 15	0 02	.. ..	.. ..	.. ..	.. ..	.. ..	23 56	23 50	23 43	23 37	23 29	23 25	23 20
10	0 40	0 31	0 25	0 19	0 14	0 10	0 02	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
11	1 01	0 57	0 54	0 51	0 49	0 47	0 43	0 40	0 37	0 34	0 31	0 28	0 26	0 23
12	1 21	1 21	1 21	1 22	1 22	1 22	1 22	1 23	1 23	1 24	1 24	1 25	1 25	1 25
13	1 40	1 44	1 48	1 51	1 54	1 56	2 01	2 04	2 08	2 12	2 15	2 20	2 22	2 25
14	2 00	2 08	2 15	2 21	2 26	2 31	2 39	2 46	2 52	2 59	3 06	3 14	3 19	3 24
15	2 22	2 34	2 44	2 53	3 00	3 07	3 18	3 28	3 37	3 46	3 56	4 08	4 15	4 22
16	2 47	3 03	3 16	3 27	3 36	3 44	3 58	4 11	4 23	4 34	4 47	5 01	5 10	5 19
17	3 16	3 36	3 51	4 04	4 15	4 25	4 41	4 55	5 09	5 23	5 37	5 54	6 04	6 15
18	3 52	4 14	4 31	4 45	4 57	5 08	5 26	5 42	5 56	6 11	6 27	6 45	6 56	7 08
19	4 35	4 58	5 16	5 31	5 43	5 54	6 13	6 29	6 44	6 59	7 16	7 35	7 45	7 58
20	5 25	5 48	6 05	6 20	6 32	6 43	7 01	7 17	7 32	7 47	8 03	8 21	8 32	8 44
21	6 22	6 43	6 59	7 12	7 24	7 34	7 51	8 06	8 20	8 33	8 48	9 05	9 15	9 26
22	7 24	7 42	7 56	8 08	8 18	8 26	8 41	8 54	9 06	9 19	9 31	9 46	9 55	10 05
23	8 30	8 44	8 56	9 05	9 13	9 20	9 32	9 43	9 52	10 02	10 13	10 25	10 32	10 39
24	9 39	9 49	9 57	10 04	10 09	10 14	10 23	10 31	10 38	10 45	10 53	11 01	11 06	11 12
25	10 50	10 55	11 00	11 04	11 07	11 10	11 15	11 19	11 23	11 27	11 32	11 37	11 40	11 43
26	12 03	12 04	12 05	12 05	12 06	12 07	12 08	12 08	12 09	12 10	12 11	12 12	12 13	12 14
27	13 18	13 15	13 12	13 09	13 07	13 05	13 02	12 59	12 57	12 54	12 52	12 49	12 47	12 45
28	14 37	14 29	14 22	14 16	14 11	14 07	13 59	13 53	13 47	13 41	13 35	13 27	13 23	13 19
29	15 59	15 45	15 34	15 25	15 18	15 11	14 59	14 49	14 40	14 31	14 21	14 10	14 03	13 56
30	17 21	17 03	16 48	16 37	16 26	16 18	16 03	15 49	15 37	15 25	15 12	14 57	14 49	14 39
31	18 41	18 19	18 02	17 48	17 36	17 26	17 08	16 52	16 38	16 24	16 08	15 51	15 41	15 29
32	19 53	19 29	19 11	18 56	18 43	18 32	18 13	17 57	17 41	17 26	17 10	16 51	16 40	16 27
33	20 53	20 30	20 12	19 58	19 45	19 35	19 16	19 00	18 45	18 30	18 14	17 56	17 45	17 33

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Dec. 9	10 18	10 29	10 38	10 45	10 52	10 57	11 07	11 16	11 23	11 31	11 39	11 49	11 54	12 00
10	11 34	11 41	11 46	11 50	11 54	11 58	12 03	12 08	12 13	12 17	12 22	12 27	12 31	12 34
11	12 49	12 51	12 52	12 53	12 54	12 55	12 57	12 58	13 00	13 01	13 02	13 04	13 04	13 05
12	14 01	13 58	13 56	13 54	13 53	13 51	13 49	13 47	13 45	13 43	13 41	13 38	13 37	13 35
13	15 11	15 04	14 58	14 54	14 50	14 46	14 40	14 34	14 29	14 24	14 19	14 13	14 09	14 05
14	16 20	16 09	16 00	15 52	15 46	15 40	15 30	15 22	15 14	15 06	14 57	14 48	14 42	14 36
15	17 27	17 12	17 00	16 50	16 41	16 34	16 21	16 09	15 59	15 48	15 37	15 24	15 17	15 08
16	18 32	18 13	17 58	17 46	17 36	17 27	17 11	16 58	16 45	16 32	16 19	16 03	15 54	15 44
17	19 33	19 11	18 54	18 41	18 29	18 19	18 01	17 46	17 32	17 18	17 02	16 45	16 35	16 23
18	20 28	20 05	19 47	19 32	19 20	19 09	18 51	18 35	18 19	18 04	17 48	17 30	17 19	17 06
19	21 16	20 53	20 35	20 21	20 08	19 57	19 39	19 23	19 07	18 52	18 36	18 17	18 06	17 54
20	21 57	21 35	21 19	21 05	20 53	20 43	20 25	20 10	19 55	19 41	19 25	19 07	18 57	18 45
21	22 31	22 12	21 57	21 45	21 34	21 25	21 09	20 55	20 42	20 29	20 15	19 59	19 49	19 39
22	22 59	22 44	22 31	22 21	22 13	22 05	21 51	21 40	21 29	21 18	21 06	20 52	20 44	20 35
23	23 23	23 12	23 03	22 55	22 48	22 42	22 32	22 23	22 14	22 06	21 57	21 46	21 40	21 33
24	23 45	23 37	23 31	23 26	23 22	23 18	23 11	23 05	23 00	22 54	22 48	22 41	22 37	22 32
25	.. ..	.. ..	23 59	23 57	23 55	23 53	23 50	23 48	23 45	23 43	23 40	23 37	23 35	23 33
26	0 05	0 02	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
27	0 25	0 26	0 27	0 28	0 28	0 29	0 30	0 31	0 32	0 33	0 33	0 34	0 35	0 36
28	0 46	0 51	0 56	1 00	1 03	1 06	1 11	1 16	1 20	1 25	1 29	1 34	1 37	1 41
29	1 09	1 20	1 28	1 35	1 41	1 47	1 56	2 04	2 12	2 19	2 28	2 37	2 42	2 49
30	1 38	1 53	2 05	2 15	2 24	2 31	2 44	2 56	3 07	3 18	3 29	3 42	3 50	3 59
31	2 14	2 33	2 49	3 01	3 12	3 22	3 38	3 52	4 06	4 19	4 33	4 50	4 59	5 10
32	3 00	3 23	3 41	3 55	4 08	4 18	4 37	4 53	5 08	5 23	5 39	5 57	6 08	6 20
33	4 00	4 24	4 42	4 57	5 10	5 21	5 40	5 56	6 12	6 27	6 43	7 02	7 13	7 26

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Dec. 9	23 20	23 18	23 15	23 13	23 10	23 07	23 04	23 00	22 56	22 52	22 47	22 41	22 35	22 27
10	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
11	0 23	0 22	0 21	0 20	0 19	0 18	0 16	0 15	0 13	0 11	0 08	0 06	0 03	0 00
12	1 25	1 25	1 25	1 26	1 26	1 26	1 26	1 26	1 27	1 27	1 27	1 28	1 28	1 29
13	2 25	2 27	2 28	2 29	2 31	2 33	2 35	2 37	2 39	2 41	2 44	2 48	2 51	2 56
14	3 24	3 27	3 29	3 32	3 35	3 38	3 41	3 45	3 50	3 54	4 00	4 06	4 13	4 21
15	4 22	4 26	4 29	4 33	4 37	4 42	4 47	4 52	4 59	5 06	5 13	5 22	5 33	5 46
16	5 19	5 24	5 28	5 33	5 38	5 44	5 51	5 58	6 06	6 15	6 25	6 37	6 51	7 08
17	6 15	6 20	6 25	6 31	6 37	6 44	6 52	7 00	7 09	7 20	7 33	7 47	8 05	8 27
18	7 08	7 13	7 19	7 26	7 32	7 40	7 48	7 58	8 08	8 20	8 34	8 51	9 11	9 37
19	7 58	8 04	8 10	8 16	8 23	8 31	8 40	8 49	9 00	9 12	9 27	9 44	10 05	10 33
20	8 44	8 50	8 56	9 02	9 09	9 16	9 25	9 34	9 44	9 56	10 10	10 26	10 46	11 12
21	9 26	9 31	9 37	9 43	9 49	9 56	10 03	10 12	10 21	10 32	10 44	10 58	11 15	11 37
22	10 05	10 09	10 14	10 18	10 24	10 30	10 36	10 43	10 51	11 00	11 10	11 22	11 36	11 52
23	10 39	10 43	10 47	10 51	10 55	11 00	11 05	11 10	11 16	11 23	11 31	11 40	11 50	12 02
24	11 12	11 14	11 17	11 20	11 23	11 26	11 30	11 34	11 38	11 43	11 48	11 55	12 02	12 10
25	11 43	11 44	11 46	11 47	11 49	11 51	11 53	11 55	11 58	12 01	12 04	12 07	12 11	12 16
26	12 14	12 14	12 14	12 15	12 15	12 15	12 16	12 16	12 17	12 17	12 18	12 19	12 20	12 21
27	12 45	12 44	12 43	12 42	12 41	12 40	12 39	12 38	12 36	12 35	12 33	12 31	12 29	12 26
28	13 19	13 17	13 14	13 12	13 10	13 07	13 04	13 01	12 57	12 54	12 49	12 44	12 39	12 32
29	13 56	13 53	13 50	13 46	13 42	13 38	13 33	13 28	13 22	13 16	13 09	13 01	12 52	12 41
30	14 39	14 35	14 30	14 25	14 20	14 14	14 08	14 01	13 53	13 45	13 35	13 23	13 10	12 54
31	15 29	15 24	15 19	15 13	15 06	14 59	14 52	14 43	14 34	14 23	14 10	13 56	13 38	13 16
32	16 27	16 22	16 16	16 09	16 02	15 55	15 46	15 37	15 26	15 14	15 00	14 43	14 22	13 56
33	17 33	17 27	17 21	17 15	17 08	17 00	16 52	16 43	16 32	16 20	16 06	15 49	15 29	15 03

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Dec. 9	12 00	12 03	12 06	12 09	12 12	12 15	12 19	12 24	12 28	12 33	12 39	12 46	12 53	13 02
10	12 34	12 36	12 37	12 39	12 41	12 43	12 45	12 48	12 50	12 53	12 56	13 00	13 04	13 09
11	13 05	13 06	13 06	13 07	13 07	13 08	13 08	13 09	13 10	13 10	13 11	13 12	13 13	13 15
12	13 35	13 35	13 34	13 33	13 32	13 31	13 30	13 29	13 28	13 27	13 25	13 24	13 22	13 19
13	14 05	14 03	14 01	13 59	13 57	13 55	13 52	13 50	13 47	13 43	13 39	13 35	13 30	13 25
14	14 36	14 33	14 30	14 27	14 23	14 20	14 16	14 11	14 06	14 01	13 55	13 48	13 40	13 31
15	15 08	15 05	15 01	14 57	14 52	14 47	14 41	14 35	14 29	14 21	14 13	14 03	13 52	13 38
16	15 44	15 39	15 35	15 29	15 24	15 18	15 11	15 03	14 55	14 46	14 35	14 22	14 08	13 50
17	16 23	16 18	16 12	16 07	16 00	15 53	15 45	15 37	15 27	15 16	15 03	14 48	14 30	14 07
18	17 06	17 01	16 55	16 48	16 42	16 34	16 25	16 16	16 05	15 53	15 39	15 22	15 02	14 35
19	17 54	17 48	17 42	17 36	17 28	17 21	17 12	17 03	16 52	16 39	16 25	16 08	15 46	15 19
20	18 45	18 39	18 34	18 27	18 21	18 13	18 05	17 56	17 46	17 34	17 20	17 04	16 44	16 19
21	19 39	19 34	19 29	19 23	19 17	19 11	19 03	18 55	18 46	18 36	18 24	18 10	17 53	17 32
22	20 35	20 31	20 27	20 22	20 17	20 11	20 05	19 59	19 51	19 43	19 33	19 22	19 09	18 53
23	21 33	21 30	21 26	21 23	21 19	21 15	21 10	21 05	21 00	20 53	20 46	20 38	20 28	20 17
24	22 32	22 30	22 28	22 26	22 23	22 20	22 17	22 14	22 10	22 06	22 02	21 56	21 50	21 43
25	23 33	23 32	23 31	23 30	23 29	23 28	23 26	23 25	23 23	23 21	23 19	23 17	23 14	23 11
26	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
27	0 36	0 36	0 36	0 37	0 37	0 37	0 38	0 38	0 39	0 39	0 40	0 40	0 41	0 42
28	1 41	1 42	1 44	1 46	1 47	1 49	1 52	1 54	1 57	2 00	2 03	2 07	2 11	2 16
29	2 49	2 51	2 54	2 57	3 01	3 04	3 08	3 13	3 18	3 23	3 30	3 37	3 45	3 55
30	3 59	4 03	4 07	4 11	4 16	4 22	4 27	4 34	4 41	4 49	4 58	5 09	5 22	5 37
31	5 10	5 15	5 20	5 26	5 32	5 39	5 46	5 55	6 04	6 14	6 26	6 41	6 58	7 19
32	6 20	6 26	6 32	6 38	6 45	6 53	7 01	7 10	7 21	7 33	7 47	8 03	8 24	8 50
33	7 26	7 31	7 37	7 44	7 51	7 58	8 07	8 16	8 27	8 39	8 53	9 10	9 31	9 57

.. .. indicates phenomenon will occur the next day.

CONTENTS OF THE ECLIPSE SECTION

SUMMARY OF ECLIPSES AND TRANSITS FOR 2017

There are four eclipses, two of the Sun and two of the Moon. All times are expressed in Universal Time using $\Delta T = +68^{s}.0$. There are no transits of Mercury or Venus across the Sun.

I. *A penumbral eclipse of the Moon*, February 10-11. See map on page 70. The eclipse begins at $22^{h}\ 32^{m}$ on February 10 and ends at $02^{h}\ 55^{m}$ on February 11. It is visible from Asia, Europe, Africa, the Middle East, South America, North America, and the Indian Ocean, the Atlantic Ocean, and the eastern Pacific Ocean.

II. *An annular eclipse of the Sun*, February 26. See map on page 72. The eclipse begins at $12^{h}\ 11^{m}$ and ends at $17^{h}\ 36^{m}$. Maximum duration of annularity is $1^{m}\ 18^{s}$. It is visible from southern South America, Antarctica, southern Africa, the south Pacific Ocean and the south Atlantic Ocean.

III. *A partial eclipse of the Moon*, August 7. See map on page 76. The eclipse begins at $15^{h}\ 48^{m}$ and ends at $20^{h}\ 53^{m}$. Time of maximum eclipse is $18^{h}\ 20^{m}$. It is visible from Australia, Antarctica, Asia, Africa, the Middle East, Europe, extreme eastern South America, the Pacific Ocean, the Indian Ocean, and the south Atlantic Ocean.

IV. *A total eclipse of the Sun*, August 21. See map on page 78. The eclipse begins at $15^{h}\ 47^{m}$ and ends at $21^{h}\ 04^{m}$. Maximum duration of totality is $02^{m}\ 45^{s}$. It is visible from North America, northern South America, western Europe, extreme western Africa, extreme eastern Asia, the north Pacific Ocean, and the north Atlantic Ocean.

Local circumstances and animations for upcoming eclipses can be found on *The Astronomical Almanac Online* at http://asa.hmnao.com or http://asa.usno.navy.mil.

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General Information

The elements and circumstances are computed according to Bessel's method from apparent right ascensions and declinations of the Sun and Moon. Semidiameters of the Sun and Moon used in the calculation of eclipses do not include irradiation. The adopted semidiameter of the Sun at unit distance is $15'\ 59''.64$ from the IAU (1976) Astronomical Constants. The apparent semidiameter of the Moon is equal to arcsin ($k \sin \pi$), where π is the Moon's horizontal parallax and k is an adopted constant. In 1982, the IAU adopted $k = 0.272\ 5076$, corresponding to the mean radius of Watts' datum as determined by observations of occultations and to the adopted radius of the Earth.

Standard corrections of $+0''.5$ and $-0''.25$ have been applied to the longitude and latitude of the Moon, respectively, to help correct for the difference between the center of figure and the center of mass.

Refraction is neglected in calculating solar and lunar eclipses. Because the circumstances of eclipses are calculated for the surface of the ellipsoid, refraction is not included in Besselian element polynomials. For local predictions, corrections for refraction are unnecessary; they are required only in precise comparisons of theory with observation in which many other refinements are also necessary.

All time arguments are given provisionally in Universal Time, using $\Delta T(A) = +68^{s}.0$. Once an updated value of ΔT is known, the data on these pages may be expressed in Universal Time as follows:

Define $\delta T = \Delta T - \Delta T(A)$, in units of seconds of time.
Change the times of circumstances given in preliminary Universal Time by subtracting δT.
Correct the tabulated longitudes, $\lambda(A)$, using $\lambda = \lambda(A) + 0.00417807 \times \delta T$ (longitudes are in degrees).
Leave all other quantities unchanged.
The correction of δT is included in the Besselian elements.
Longitude is positive to the east, and negative to the west.

Explanation of Solar Eclipse Diagram

The solar eclipse diagrams in *The Astronomical Almanac* show the region over which different phases of each eclipse may be seen and the times at which these phases occur. Each diagram has a series of dashed curves that show the outline of the Moon's penumbra on the Earth's surface at one-hour intervals. Short dashes show the leading edge and long dashes show the trailing edge. Except for certain extreme cases, the shadow outline moves generally from west to east. The Moon's shadow cone first contacts the Earth's surface where "First Contact" is indicated on the diagram. "Last Contact" is where the Moon's shadow cone last contacts the Earth's surface. The path of the central eclipse, whether for a total, annular, or annular-total eclipse, is marked by two closely spaced curves that cut across all of the dashed curves. These two curves mark the extent of the Moon's umbral shadow on the Earth's surface. Viewers within these boundaries will observe a total, annular, or annular-total eclipse and viewers outside these boundaries will see a partial eclipse.

Solid curves labeled "Northern" and "Southern Limit of Eclipse" represent the furthest extent north or south of the Moon's penumbra on the Earth's surface. Viewers outside of

these boundaries will not experience any eclipse. When only one of these two curves appears, only part of the Moon's penumbra touches the Earth; the other part is projected into space north or south of the Earth, and the terminator defines the other limit.

Another set of solid curves appears on some diagrams as two teardrop shapes (or lobes) on either end of the eclipse path, and on other diagrams as a distorted figure eight. These lobes represent in time the intersection of the Moon's penumbra with the Earth's terminator as the eclipse progresses. As time elapses, the Earth's terminator moves east-to-west while the Moon's penumbra moves west-to-east. These lobes connect to form an elongated figure eight on a diagram when part of the Moon's penumbra stays in contact with the Earth's terminator throughout the eclipse. The lobes become two separate teardrop shapes when the Moon's penumbra breaks contact with the Earth's terminator during the beginning of the eclipse and reconnects with it near the end. In the east, the outer portion of the lobe is labeled "Eclipse begins at Sunset" and marks the first contact between the Moon's penumbra and Earth's terminator in the east. Observers on this curve just fail to see the eclipse. The inner part of the lobe is labeled "Eclipse ends at Sunset" and marks the last contact between the Moon's penumbra and the Earth's terminator in the east. Observers on this curve just see the whole eclipse. The curve bisecting this lobe is labeled "Maximum Eclipse at Sunset" and is part of the sunset terminator at maximum eclipse. Viewers in the eastern half of the lobe will see the Sun set before maximum eclipse; *i.e.* see less than half of the eclipse. Viewers in the western half of the lobe will see the Sun set after maximum eclipse; *i.e.* see more than half of the eclipse. A similar description holds for the western lobe except everything occurs at sunrise instead of sunset.

Computing Local Circumstances for Solar Eclipses

The solar eclipse maps show the path of the eclipse, beginning and ending times of the eclipse, and the region of visibility, including restrictions due to rising and setting of the Sun. The short-dash and long-dash lines show, respectively, the progress of the leading and trailing edge of the penumbra; thus, at a given location, the times of the first and last contact may be interpolated. If further precision is desired, Besselian elements can be utilized.

Besselian elements characterize the geometric position of the shadow of the Moon relative to the Earth. The exterior tangents to the surfaces of the Sun and Moon form the umbral cone; the interior tangents form the penumbral cone. The common axis of these two cones is the axis of the shadow. To form a system of geocentric rectangular coordinates, the geocentric plane perpendicular to the axis of the shadow is taken as the xy-plane. This is called the fundamental plane. The x-axis is the intersection of the fundamental plane with the plane of the equator; it is positive toward the east. The y-axis is positive toward the north. The z-axis is parallel to the axis of the shadow and is positive toward the Moon. The tabular values of x and y are the coordinates, in units of the Earth's equatorial radius, of the intersection of the axis of the shadow with the fundamental plane. The direction of the axis of the shadow is specified by the declination d and hour angle μ of the point on the celestial sphere toward which the axis is directed.

The radius of the umbral cone is regarded as positive for an annular eclipse and negative for a total eclipse. The angles f_1 and f_2 are the angles at which the tangents that form the penumbral and umbral cones, respectively, intersect the axis of the shadow.

To predict accurate local circumstances, calculate the geocentric coordinates $\rho \sin \phi'$ and $\rho \cos \phi'$ from the geodetic latitude ϕ and longitude λ, using the relationships given on pages K11–K12 of *The Astronomical Almanac*. Inclusion of the height h in this calculation is all that is necessary to obtain the local circumstances at high altitudes.

Obtain approximate times for the beginning, middle and end of the eclipse from the eclipse map. For each of these three times compute — from the Besselian element polynomials — the values of x, y, $\sin d$, $\cos d$, μ and l_1 (the radius of the penumbra on the fundamental plane). If the eclipse is central (i.e., total, annular or annular-total), then, at the approximate time of the middle of the eclipse, l_2 (the radius of the umbra on the fundamental plane) is required instead of l_1. The hourly variations x', y' of x and y are needed, and may be obtained by evaluating the derivative of the polynomial expressions for x and y. Values of μ', d', $\tan f_1$ and $\tan f_2$ are nearly constant throughout the eclipse and are given immediately following the Besselian polynomials.

For each of the three approximate times, calculate the coordinates ξ, η, ζ for the observer and the hourly variations ξ' and η' from

$$\begin{aligned}
\xi &= \rho\cos\phi'\sin\theta,\\
\eta &= \rho\sin\phi'\cos d - \rho\cos\phi'\sin d\cos\theta,\\
\zeta &= \rho\sin\phi'\sin d + \rho\cos\phi'\cos d\cos\theta,\\
\xi' &= \mu'\rho\cos\phi'\cos\theta,\\
\eta' &= \mu'\xi\sin d - \zeta d',
\end{aligned}$$

where

$$\theta = \mu + \lambda$$

for longitudes measured positive towards the east.

Next, calculate

$$\begin{aligned}
u &= x - \xi & u' &= x' - \xi'\\
v &= y - \eta & v' &= y' - \eta'\\
m^2 &= u^2 + v^2 & n^2 &= u'^2 + v'^2 \qquad (m, n > 0)\\
L_i &= l_i - \zeta\tan f_i\\
D &= uu' + vv'\\
\Delta &= \tfrac{1}{n}(uv' - u'v)\\
\sin\psi &= \tfrac{\Delta}{L_i}
\end{aligned}$$

where $i = 1, 2$.

At the approximate times of the beginning and end of the eclipse, L_1 is required. At the approximate time of the middle of the eclipse, L_2 is required if the eclipse is central; L_1 is required if the eclipse is partial.

Neglecting the variation of L, the correction τ to be applied to the approximate time of the middle of the eclipse to obtain the *Universal Time of greatest phase* (in hours) is

$$\tau = -\frac{D}{n^2},$$

which may be expressed in minutes by multiplying by 60. The correction τ to be applied to the approximate times of the beginning and end of the eclipse to obtain the *Universal Times of the penumbral contacts* (in hours) is

$$\tau = \frac{L_1}{n}\cos\psi - \frac{D}{n^2},$$

which may be expressed in minutes by multiplying by 60.

If the eclipse is central, use the approximate time for the middle of the eclipse as a first approximation to the times of umbral contact. The correction τ to be applied to obtain the *Universal Times of the umbral contacts* is

$$\tau = \frac{L_2}{n}\cos\psi - \frac{D}{n^2},$$

which may be expressed in minutes by multiplying by 60.

In the last two equations, the ambiguity in the quadrant of ψ is removed by noting that $\cos\psi$ must be *negative* for the beginning of the eclipse, for the beginning of the annular phase, or for the end of the total phase; $\cos\psi$ must be *positive* for the end of the eclipse, the end of the annular phase, or the beginning of the total phase.

For greater accuracy, the times resulting from the calculation outlined above should be used in place of the original approximate times, and the entire procedure repeated at least once. The calculations for each of the contact times and the time of greatest phase should be performed separately.

The *magnitude of greatest partial eclipse*, in units of the solar diameter is

$$M_1 = \frac{L_1 - m}{(2L_1 - 0.5459)},$$

where the value of m at the time of greatest phase is used. If the magnitude is negative at the time of greatest phase, no eclipse is visible from the location.

The *magnitude of the central phase*, in the same units is

$$M_2 = \frac{L_1 - L_2}{(L_1 + L_2)}.$$

The *position angle of a point of contact* measured eastward (counterclockwise) from the north point of the solar limb is given by

$$\tan P = \frac{u}{v},$$

where u and v are evaluated at the times of contacts computed in the final approximation. The quadrant of P is determined by noting that $\sin P$ has the algebraic sign of u, except for the contacts of the total phase, for which $\sin P$ has the opposite sign to u.

The position angle of the point of contact measured eastward from the vertex of the solar limb is given by

$$V = P - C,$$

where C, the parallactic angle, is obtained with sufficient accuracy from

$$\tan C = \frac{\xi}{\eta},$$

with $\sin C$ having the same algebraic sign as ξ, and the results of the final approximation again being used. The vertex point of the solar limb lies on a great circle arc drawn from the zenith to the center of the solar disk.

Lunar Eclipses

A calculator to produce local circumstances of recent and upcoming lunar eclipses is provided at http://aa.usno.navy.mil/data/docs/LunarEclipse.php

In calculating lunar eclipses the radius of the geocentric shadow of the Earth is increased by one-fiftieth part to allow for the effect of the atmosphere. Refraction is neglected in calculating solar and lunar eclipses. Standard corrections of $+0''.5$ and $-0''.25$ have been applied to the longitude and latitude of the Moon, respectively, to help correct for the difference between the center of figure and the center of mass.

Explanation of Lunar Eclipse Diagram

Information on lunar eclipses is presented in the form of a diagram consisting of two parts. The upper panel shows the path of the Moon relative to the penumbral and umbral shadows of the Earth. The lower panel shows the visibility of the eclipse from the surface of the Earth. The title of the upper panel includes the type of eclipse, its place in the sequence of eclipses for the year and the Greenwich calendar date of the eclipse. The inner darker circle is the umbral shadow of the Earth and the outer lighter circle is that of the penumbra. The axis of the shadow of the Earth is denoted by (+) with the ecliptic shown for reference purposes. A 30-arcminute scale bar is provided on the right hand side of the diagram and the orientation is given by the cardinal points displayed on the small graphic on the left hand side of the diagram. The position angle (PA) is measured from North point of the lunar disk along the limb of the Moon to the point of contact. It is shown on the graphic by the use of an arc extending anti-clockwise (eastwards) from North terminated with an arrow head.

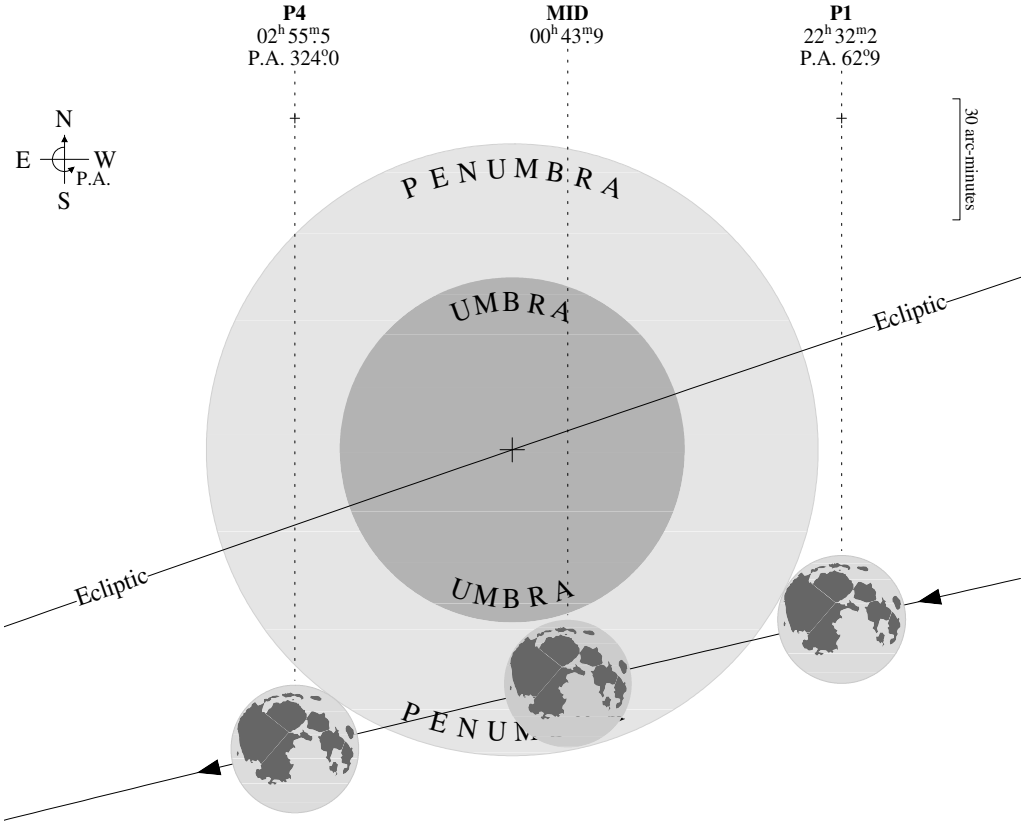
Moon symbols are plotted at the principal phases of the eclipse to show its position relative to the umbral and penumbral shadows. The UT times of the different phases of the eclipse to the nearest tenth of a minute are printed above or below the Moon symbols as appropriate. P1 and P4 are the first and last external contacts of the penumbra respectively and denote the beginning and end of the penumbral eclipse respectively. U1 and U4 are the first and last external contacts of the umbra denoting the beginning and end of the partial phase of the eclipse respectively. U2 and U3 are the first and last internal contacts of the umbra and denote the beginning and end of the total phase respectively. MID is the middle of the eclipse. The position angle is given for P1 and P4 for penumbral eclipses and U1 and U4 for partial and total eclipses. The UT time of the geocentric opposition in right ascension of the Sun and Moon and the magnitude of the eclipse are given above or below the Moon symbols as appropriate.

The lower panel is a cylindrical equidistant map projection showing the Earth centered on the longitude at which the Moon is in the zenith at the middle of the eclipse. The visibility of the eclipse is displayed by plotting the Moon rise/set terminator for the principal phases of the eclipse for which timing information is provided in the upper panel. The terminator for the middle of the eclipse is not plotted for the sake of clarity.

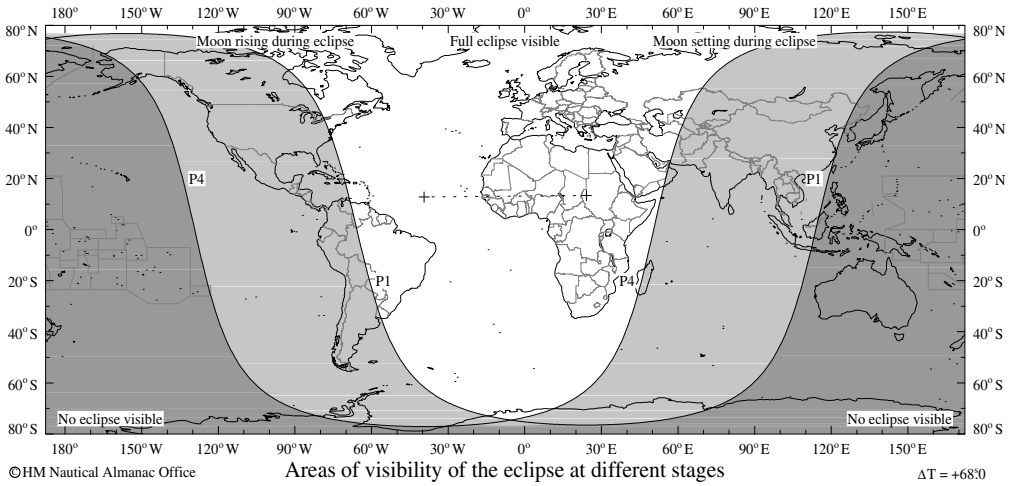
The unshaded area indicates the region of the Earth from which all the eclipse is visible whereas the darkest shading indicates the area from which the eclipse is invisible. The different shades of gray indicate regions where the Moon is either rising or setting during the principal phases of the eclipse. The Moon is rising on the left hand side of the diagram after the eclipse has started and is setting on the right hand side of the diagram before the eclipse ends. Labels are provided to this effect.

Symbols are plotted showing the locations for which the Moon is in the zenith at the principal phases of the eclipse. The points at which the Moon is in the zenith at P1 and P4 are denoted by (+), at U1 and U4 by ($\odot$) and at U2 and U3 by ($\oplus$). These symbols are also plotted on the upper panel where appropriate. The value of ΔT used for the calculation of the eclipse circumstances is given below the diagram. Country boundaries are also provided to assist the user in determining the visibility of the eclipse at a particular location.

I. - Penumbral Eclipse of the Moon 2017 February 10-11



UT of geocentric opposition in RA: February 11d 1h 10m 40s.247 Penumbral magnitude of the eclipse: 1.014



Areas of visibility of the eclipse at different stages

ΔT = +68s.0

II. – Annular Eclipse of the Sun, 2017 February 26

CIRCUMSTANCES OF THE ECLIPSE

Universal Time of geocentric conjunction in right ascension, February $26^{d}\ 14^{h}\ 38^{m}\ 45^{s}.414$
Julian Date = 2457811.1102478420

		UT d	h	m	Longitude °	′	Latitude °	′
Eclipse begins	February	26	12	10.8	– 95	06.8	–33	09.3
Beginning of northern limit of umbra		26	13	15.7	–113	40.4	–42	44.2
Beginning of center line; central eclipse begins		26	13	16.1	–113	53.1	–43	08.0
Beginning of southern limit of umbra		26	13	16.5	–114	05.9	–43	31.7
Central eclipse at local apparent noon		26	14	38.8	– 36	29.2	–37	12.5
End of southern limit of umbra		26	16	30.5	+ 27	16.8	–11	18.3
End of center line; central eclipse ends		26	16	30.9	+ 27	07.7	–10	55.8
End of northern limit of umbra		26	16	31.2	+ 26	58.7	–10	33.3
Eclipse ends		26	17	36.0	+ 9	19.1	– 0	52.3

BESSELIAN ELEMENTS

Let $t = (\mathrm{UT} - 12^{h}) + \delta T/3600$ in units of hours.

These equations are valid over the range $0^{h}.125 \le t \le 5^{h}.775$. Do not use t outside the given range, and do not omit any terms in the series. If μ is greater than 360°, then subtract 360° from its computed value.

Intersection of the axis of shadow with the fundamental plane:

$$x = -1.38992435 + 0.52519593\ t + 0.00006005\ t^2 - 0.00000741\ t^3$$
$$y = -0.88173421 + 0.15272622\ t + 0.00009781\ t^2 - 0.00000208\ t^3$$

Direction of the axis of shadow:

$$\sin d = -0.14845036 + 0.00026323\ t + 0.00000003\ t^2$$
$$\cos d = +0.98891983 + 0.00003955\ t - 0.00000004\ t^2$$
$$\mu = 356^{\circ}.78898450 + 15.00307290\ t + 0.00000209\ t^2 - 0.00000002\ t^3 - 0.00417807\ \delta T$$

Radius of the shadow on the fundamental plane:

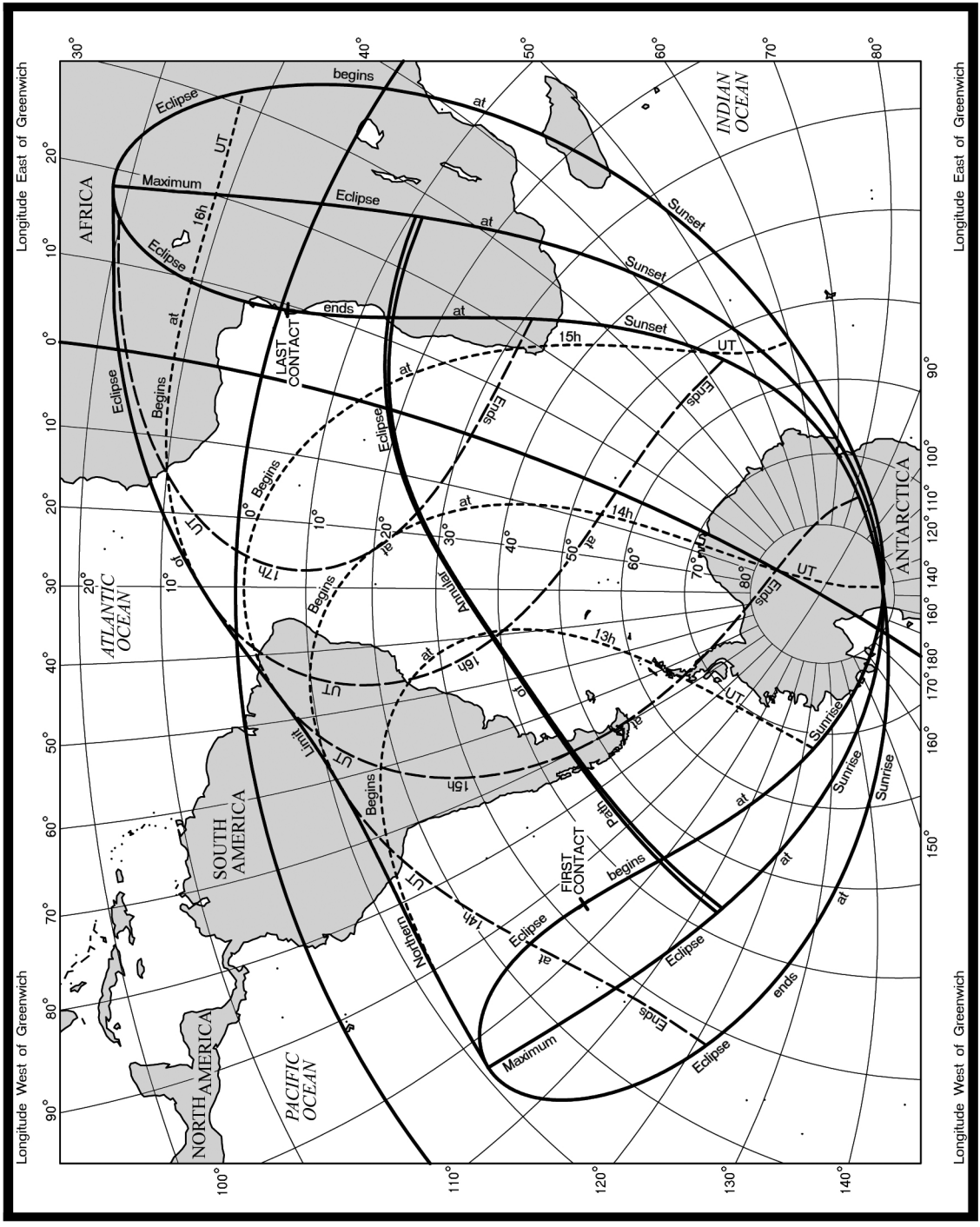
$$\text{penumbra } (l_1) = +0.55276471 - 0.00005696\ t - 0.00001152\ t^2$$
$$\text{umbra } (l_2) = +0.00634720 - 0.00005671\ t - 0.00001146\ t^2$$

Other important quantities:

$$\tan f_1 = +0.004722$$
$$\tan f_2 = +0.004698$$
$$\mu' = +0.261853 \text{ radians per hour}$$
$$d' = +0.000266 \text{ radians per hour}$$

All time arguments are given provisionally in Universal Time, using $\Delta T(A) = 68^{s}.0$.

ANNULAR SOLAR ECLIPSE OF 2017 FEBRUARY 26



PATH OF CENTRAL PHASE: ANNULAR SOLAR ECLIPSE OF FEBRUARY 26

For limits, see Circumstances of the Eclipse.

Longitude	Latitude of: Northern Limit	Central Line	Southern Limit	Universal Time at: Northern Limit	Central Line	Southern Limit	On Central Line: Maximum Duration	Sun's Alt.	Sun's Az.
° ′	° ′	° ′	° ′	h m s	h m s	h m s	m s	°	°
−106 00	−43 49.3	−44 12.6	−44 36.0	13 16 23.9	13 16 47.4	13 17 10.4	1 17.0	6	96
−105 00	−43 57.0	−44 19.9	−44 42.9	13 16 33.6	13 16 57.2	13 17 20.9	1 16.6	7	95
−104 00	−44 04.2	−44 27.0	−44 49.8	13 16 45.7	13 17 08.6	13 17 31.7	1 16.3	7	95
−103 00	−44 11.2	−44 33.7	−44 56.2	13 16 59.5	13 17 22.1	13 17 44.9	1 15.9	8	94
−102 00	−44 17.9	−44 40.1	−45 02.3	13 17 14.4	13 17 36.9	13 17 59.5	1 15.5	9	93
−101 00	−44 24.3	−44 46.2	−45 08.2	13 17 30.8	13 17 53.0	13 18 15.3	1 15.1	10	92
−100 00	−44 30.5	−44 52.1	−45 13.7	13 17 48.4	13 18 10.4	13 18 32.6	1 14.8	10	92
− 99 00	−44 36.4	−44 57.8	−45 19.1	13 18 07.5	13 18 29.3	13 18 51.1	1 14.4	11	91
− 98 00	−44 42.1	−45 03.1	−45 24.1	13 18 27.9	13 18 49.4	13 19 11.0	1 14.0	12	90
− 97 00	−44 47.4	−45 08.2	−45 28.9	13 18 49.7	13 19 11.0	13 19 32.3	1 13.6	13	89
− 96 00	−44 52.5	−45 12.9	−45 33.4	13 19 12.9	13 19 33.9	13 19 54.9	1 13.2	14	88
− 95 00	−44 57.3	−45 17.4	−45 37.6	13 19 37.6	13 19 58.2	13 20 18.9	1 12.8	14	88
− 94 00	−45 01.8	−45 21.6	−45 41.5	13 20 03.6	13 20 23.9	13 20 44.3	1 12.3	15	87
− 93 00	−45 05.9	−45 25.5	−45 45.2	13 20 31.1	13 20 51.1	13 21 11.1	1 11.9	16	86
− 92 00	−45 09.8	−45 29.1	−45 48.5	13 21 00.1	13 21 19.7	13 21 39.4	1 11.5	17	85
− 91 00	−45 13.4	−45 32.4	−45 51.5	13 21 30.5	13 21 49.7	13 22 09.0	1 11.1	17	84
− 90 00	−45 16.6	−45 35.4	−45 54.2	13 22 02.3	13 22 21.2	13 22 40.1	1 10.6	18	84
− 89 00	−45 19.6	−45 38.0	−45 56.6	13 22 35.7	13 22 54.2	13 23 12.7	1 10.2	19	83
− 88 00	−45 22.2	−45 40.4	−45 58.6	13 23 10.5	13 23 28.6	13 23 46.8	1 09.7	20	82
− 87 00	−45 24.4	−45 42.4	−46 00.3	13 23 46.9	13 24 04.6	13 24 22.3	1 09.3	21	81
− 86 00	−45 26.4	−45 44.0	−46 01.7	13 24 24.8	13 24 42.1	13 24 59.4	1 08.8	21	80
− 85 00	−45 27.9	−45 45.3	−46 02.8	13 25 04.3	13 25 21.1	13 25 37.9	1 08.3	22	79
− 84 00	−45 29.2	−45 46.3	−46 03.5	13 25 45.3	13 26 01.7	13 26 18.0	1 07.9	23	78
− 83 00	−45 30.1	−45 46.9	−46 03.9	13 26 27.9	13 26 43.8	13 26 59.7	1 07.4	24	77
− 82 00	−45 30.6	−45 47.2	−46 03.9	13 27 12.1	13 27 27.6	13 27 43.0	1 06.9	25	76
− 81 00	−45 30.7	−45 47.1	−46 03.5	13 27 58.0	13 28 12.9	13 28 27.9	1 06.4	25	75
− 80 00	−45 30.5	−45 46.6	−46 02.8	13 28 45.5	13 28 59.9	13 29 14.4	1 05.9	26	74
− 79 00	−45 29.9	−45 45.8	−46 01.7	13 29 34.7	13 29 48.6	13 30 02.6	1 05.4	27	73
− 78 00	−45 29.0	−45 44.6	−46 00.2	13 30 25.5	13 30 39.0	13 30 52.4	1 04.9	28	72
− 77 00	−45 27.6	−45 42.9	−45 58.4	13 31 18.1	13 31 31.0	13 31 44.0	1 04.3	29	71
− 76 00	−45 25.8	−45 40.9	−45 56.1	13 32 12.5	13 32 24.8	13 32 37.2	1 03.8	29	70
− 75 00	−45 23.6	−45 38.5	−45 53.4	13 33 08.6	13 33 20.4	13 33 32.3	1 03.3	30	69
− 74 00	−45 21.0	−45 35.7	−45 50.4	13 34 06.5	13 34 17.8	13 34 29.1	1 02.7	31	68
− 73 00	−45 18.0	−45 32.4	−45 46.9	13 35 06.3	13 35 17.1	13 35 27.8	1 02.2	32	67
− 72 00	−45 14.5	−45 28.7	−45 43.0	13 36 08.0	13 36 18.1	13 36 28.3	1 01.6	33	66
− 71 00	−45 10.7	−45 24.6	−45 38.6	13 37 11.5	13 37 21.1	13 37 30.8	1 01.1	34	65
− 70 00	−45 06.3	−45 20.0	−45 33.8	13 38 17.0	13 38 26.1	13 38 35.1	1 00.5	34	64
− 69 00	−45 01.5	−45 15.0	−45 28.6	13 39 24.5	13 39 33.0	13 39 41.5	0 59.9	35	63
− 68 00	−44 56.2	−45 09.5	−45 22.9	13 40 34.0	13 40 41.9	13 40 49.8	0 59.3	36	62
− 67 00	−44 50.5	−45 03.6	−45 16.7	13 41 45.5	13 41 52.8	13 42 00.2	0 58.7	37	61
− 66 00	−44 44.3	−44 57.1	−45 10.0	13 42 59.2	13 43 05.9	13 43 12.7	0 58.1	38	59
− 65 00	−44 37.5	−44 50.2	−45 02.9	13 44 15.0	13 44 21.1	13 44 27.3	0 57.5	39	58
− 64 00	−44 30.3	−44 42.7	−44 55.2	13 45 32.9	13 45 38.5	13 45 44.1	0 56.9	40	57
− 63 00	−44 22.6	−44 34.8	−44 47.1	13 46 53.1	13 46 58.1	13 47 03.1	0 56.3	40	56
− 62 00	−44 14.3	−44 26.3	−44 38.4	13 48 15.6	13 48 20.0	13 48 24.4	0 55.7	41	54
− 61 00	−44 05.4	−44 17.3	−44 29.2	13 49 40.5	13 49 44.3	13 49 48.1	0 55.1	42	53
− 60 00	−43 56.1	−44 07.7	−44 19.4	13 51 07.7	13 51 10.9	13 51 14.1	0 54.5	43	52
− 59 00	−43 46.1	−43 57.6	−44 09.1	13 52 37.3	13 52 39.9	13 52 42.6	0 53.8	44	50
− 58 00	−43 35.6	−43 46.9	−43 58.2	13 54 09.5	13 54 11.5	13 54 13.5	0 53.2	45	49
− 57 00	−43 24.5	−43 35.6	−43 46.8	13 55 44.2	13 55 45.6	13 55 47.0	0 52.6	46	47

PATH OF CENTRAL PHASE: ANNULAR SOLAR ECLIPSE OF FEBRUARY 26

Longitude	Latitude of: Northern Limit	Central Line	Southern Limit	Universal Time at: Northern Limit	Central Line	Southern Limit	On Central Line: Maximum Duration	Sun's Alt.	Sun's Az.
° ′	° ′	° ′	° ′	h m s	h m s	h m s	m s	°	°
− 56 00	−43 12.8	−43 23.7	−43 34.7	13 57 21.5	13 57 22.3	13 57 23.1	0 51.9	46	46
− 55 00	−43 00.5	−43 11.2	−43 22.0	13 59 01.4	13 59 01.7	13 59 01.9	0 51.3	47	44
− 54 00	−42 47.5	−42 58.1	−43 08.7	14 00 44.1	14 00 43.8	14 00 43.4	0 50.7	48	42
− 53 00	−42 33.9	−42 44.3	−42 54.8	14 02 29.5	14 02 28.6	14 02 27.7	0 50.0	49	41
− 52 00	−42 19.6	−42 29.9	−42 40.2	14 04 17.8	14 04 16.3	14 04 14.8	0 49.4	50	39
− 51 00	−42 04.7	−42 14.8	−42 25.0	14 06 09.0	14 06 06.9	14 06 04.9	0 48.7	51	37
− 50 00	−41 49.0	−41 59.0	−42 09.0	14 08 03.1	14 08 00.5	14 07 57.8	0 48.1	52	35
− 49 00	−41 32.7	−41 42.5	−41 52.4	14 10 00.3	14 09 57.1	14 09 53.8	0 47.5	53	33
− 48 00	−41 15.7	−41 25.4	−41 35.1	14 12 00.5	14 11 56.7	14 11 52.9	0 46.9	53	31
− 47 00	−40 57.9	−41 07.4	−41 17.1	14 14 03.8	14 13 59.4	14 13 55.1	0 46.2	54	29
− 46 00	−40 39.4	−40 48.8	−40 58.3	14 16 10.2	14 16 05.3	14 16 00.4	0 45.6	55	27
− 45 00	−40 20.1	−40 29.4	−40 38.8	14 18 19.8	14 18 14.4	14 18 09.0	0 45.1	56	25
− 44 00	−40 00.0	−40 09.2	−40 18.5	14 20 32.7	14 20 26.8	14 20 20.8	0 44.5	57	22
− 43 00	−39 39.2	−39 48.3	−39 57.5	14 22 48.8	14 22 42.3	14 22 35.8	0 43.9	57	20
− 42 00	−39 17.6	−39 26.6	−39 35.7	14 25 08.2	14 25 01.2	14 24 54.2	0 43.4	58	17
− 41 00	−38 55.1	−39 04.1	−39 13.1	14 27 30.9	14 27 23.4	14 27 15.8	0 42.8	59	14
− 40 00	−38 31.9	−38 40.8	−38 49.7	14 29 56.9	14 29 48.8	14 29 40.7	0 42.3	59	11
− 39 00	−38 07.8	−38 16.7	−38 25.5	14 32 26.1	14 32 17.5	14 32 08.9	0 41.9	60	8
− 38 00	−37 43.0	−37 51.7	−38 00.5	14 34 58.6	14 34 49.5	14 34 40.4	0 41.4	61	5
− 37 00	−37 17.3	−37 26.0	−37 34.8	14 37 34.2	14 37 24.6	14 37 15.0	0 41.0	61	2
− 36 00	−36 50.8	−36 59.5	−37 08.2	14 40 13.0	14 40 02.8	14 39 52.7	0 40.6	61	358
− 35 00	−36 23.6	−36 32.2	−36 40.9	14 42 54.7	14 42 44.1	14 42 33.4	0 40.3	62	355
− 34 00	−35 55.5	−36 04.1	−36 12.8	14 45 39.4	14 45 28.2	14 45 17.1	0 40.0	62	351
− 33 00	−35 26.7	−35 35.3	−35 44.0	14 48 26.8	14 48 15.1	14 48 03.5	0 39.7	62	347
− 32 00	−34 57.1	−35 05.7	−35 14.4	14 51 16.7	14 51 04.6	14 50 52.4	0 39.5	63	344
− 31 00	−34 26.8	−34 35.4	−34 44.2	14 54 09.1	14 53 56.4	14 53 43.8	0 39.4	63	340
− 30 00	−33 55.8	−34 04.5	−34 13.3	14 57 03.6	14 56 50.4	14 56 37.2	0 39.3	62	336
− 29 00	−33 24.1	−33 32.9	−33 41.7	15 00 00.0	14 59 46.3	14 59 32.6	0 39.2	62	332
− 28 00	−32 51.8	−33 00.7	−33 09.6	15 02 57.9	15 02 43.8	15 02 29.6	0 39.2	62	328
− 27 00	−32 19.0	−32 28.0	−32 37.0	15 05 57.2	15 05 42.5	15 05 27.8	0 39.3	62	324
− 26 00	−31 45.7	−31 54.7	−32 03.8	15 08 57.4	15 08 42.2	15 08 27.0	0 39.4	61	321
− 25 00	−31 11.9	−31 21.1	−31 30.3	15 11 58.1	15 11 42.4	15 11 26.7	0 39.6	61	317
− 24 00	−30 37.7	−30 47.0	−30 56.4	15 14 59.0	15 14 42.8	15 14 26.5	0 39.8	60	314
− 23 00	−30 03.2	−30 12.7	−30 22.2	15 17 59.7	15 17 42.9	15 17 26.2	0 40.1	59	310
− 22 00	−29 28.5	−29 38.2	−29 47.9	15 20 59.7	15 20 42.4	15 20 25.2	0 40.4	58	307
− 21 00	−28 53.6	−29 03.5	−29 13.4	15 23 58.6	15 23 40.8	15 23 23.1	0 40.9	58	304
− 20 00	−28 18.7	−28 28.7	−28 38.8	15 26 56.0	15 26 37.8	15 26 19.5	0 41.3	57	301
− 19 00	−27 43.7	−27 53.9	−28 04.2	15 29 51.5	15 29 32.8	15 29 14.1	0 41.8	56	298
− 18 00	−27 08.8	−27 19.2	−27 29.8	15 32 44.7	15 32 25.5	15 32 06.3	0 42.4	54	296
− 17 00	−26 34.0	−26 44.7	−26 55.5	15 35 35.2	15 35 15.5	15 34 55.8	0 43.0	53	294
− 16 00	−25 59.4	−26 10.4	−26 21.4	15 38 22.6	15 38 02.5	15 37 42.4	0 43.7	52	291
− 15 00	−25 25.1	−25 36.4	−25 47.6	15 41 06.6	15 40 46.1	15 40 25.5	0 44.4	51	289
− 14 00	−24 51.2	−25 02.7	−25 14.2	15 43 47.0	15 43 26.0	15 43 05.0	0 45.1	50	287
− 13 00	−24 17.6	−24 29.4	−24 41.2	15 46 23.3	15 46 01.9	15 45 40.6	0 45.8	48	286
− 12 00	−23 44.6	−23 56.6	−24 08.7	15 48 55.4	15 48 33.7	15 48 11.9	0 46.6	47	284
− 11 00	−23 12.0	−23 24.4	−23 36.7	15 51 23.1	15 51 01.0	15 50 38.9	0 47.4	46	282
− 10 00	−22 40.0	−22 52.6	−23 05.3	15 53 46.2	15 53 23.8	15 53 01.4	0 48.3	44	281
− 9 00	−22 08.5	−22 21.5	−22 34.5	15 56 04.6	15 55 41.9	15 55 19.2	0 49.1	43	280
− 8 00	−21 37.7	−21 51.0	−22 04.3	15 58 18.1	15 57 55.1	15 57 32.2	0 49.9	42	278
− 7 00	−21 07.5	−21 21.1	−21 34.7	16 00 26.8	16 00 03.5	15 59 40.3	0 50.8	40	277

PATH OF CENTRAL PHASE: ANNULAR SOLAR ECLIPSE OF FEBRUARY 26

Longitude	Latitude of: Northern Limit	Latitude of: Central Line	Latitude of: Southern Limit	Universal Time at: Northern Limit	Universal Time at: Central Line	Universal Time at: Southern Limit	On Central Line: Maximum Duration	On Central Line: Sun's Alt.	On Central Line: Sun's Az.
° ′	° ′	° ′	° ′	h m s	h m s	h m s	m s	°	°
− 6 00	−20 38.0	−20 51.9	−21 05.9	16 02 30.4	16 02 07.0	16 01 43.6	0 51.6	39	276
− 5 00	−20 09.2	−20 23.4	−20 37.7	16 04 29.2	16 04 05.5	16 03 41.9	0 52.5	38	275
− 4 00	−19 41.1	−19 55.6	−20 10.2	16 06 22.9	16 05 59.1	16 05 35.3	0 53.4	36	274
− 3 00	−19 13.7	−19 28.6	−19 43.4	16 08 11.7	16 07 47.7	16 07 23.8	0 54.2	35	273
− 2 00	−18 47.0	−19 02.2	−19 17.4	16 09 55.5	16 09 31.5	16 09 07.4	0 55.1	34	272
− 1 00	−18 21.0	−18 36.6	−18 52.1	16 11 34.5	16 11 10.4	16 10 46.2	0 55.9	32	272
0 00	−17 55.8	−18 11.6	−18 27.5	16 13 08.7	16 12 44.5	16 12 20.3	0 56.8	31	271
+ 1 00	−17 31.3	−17 47.4	−18 03.6	16 14 38.2	16 14 13.9	16 13 49.6	0 57.6	30	270
+ 2 00	−17 07.5	−17 23.9	−17 40.4	16 16 03.1	16 15 38.7	16 15 14.4	0 58.4	28	270
+ 3 00	−16 44.3	−17 01.1	−17 17.9	16 17 23.4	16 16 59.0	16 16 34.7	0 59.2	27	269
+ 4 00	−16 21.9	−16 39.0	−16 56.1	16 18 39.2	16 18 14.9	16 17 50.5	1 00.0	26	269
+ 5 00	−16 00.2	−16 17.6	−16 35.0	16 19 50.8	16 19 26.4	16 19 02.1	1 00.8	25	268
+ 6 00	−15 39.2	−15 56.9	−16 14.6	16 20 58.1	16 20 33.7	16 20 09.4	1 01.6	23	268
+ 7 00	−15 18.8	−15 36.8	−15 54.9	16 22 01.2	16 21 36.9	16 21 12.6	1 02.3	22	267
+ 8 00	−14 59.1	−15 17.4	−15 35.8	16 23 00.4	16 22 36.1	16 22 11.8	1 03.0	21	267
+ 9 00	−14 40.0	−14 58.7	−15 17.3	16 23 55.6	16 23 31.4	16 23 07.2	1 03.8	20	266
+ 10 00	−14 21.6	−14 40.5	−14 59.5	16 24 47.0	16 24 22.9	16 23 58.7	1 04.5	19	266
+ 11 00	−14 03.8	−14 23.0	−14 42.3	16 25 34.7	16 25 10.7	16 24 46.6	1 05.2	17	265
+ 12 00	−13 46.6	−14 06.1	−14 25.7	16 26 18.8	16 25 54.9	16 25 30.9	1 05.9	16	265
+ 13 00	−13 30.0	−13 49.8	−14 09.7	16 26 59.5	16 26 35.6	16 26 11.7	1 06.5	15	265
+ 14 00	−13 13.9	−13 34.1	−13 54.3	16 27 36.7	16 27 13.0	16 26 49.1	1 07.2	14	264
+ 15 00	−12 58.5	−13 18.9	−13 39.4	16 28 10.7	16 27 47.0	16 27 23.3	1 07.8	13	264
+ 16 00	−12 43.6	−13 04.3	−13 25.1	16 28 41.4	16 28 17.9	16 27 54.3	1 08.4	12	264
+ 17 00	−12 29.2	−12 50.3	−13 11.3	16 29 09.1	16 28 45.7	16 28 22.2	1 09.1	11	264
+ 18 00	−12 15.4	−12 36.7	−12 58.1	16 29 33.8	16 29 10.5	16 28 47.1	1 09.7	9	263
+ 19 00	−12 02.1	−12 23.7	−12 45.3	16 29 55.5	16 29 32.3	16 29 09.1	1 10.2	8	263
+ 20 00	−11 49.3	−12 11.2	−12 33.1	16 30 14.7	16 29 51.5	16 29 28.2	1 10.8	7	263
+ 21 00	−11 37.0	−11 59.4	−12 21.6	16 30 30.4	16 30 06.5	16 29 43.2	1 11.4	6	263
+ 22 00	−11 25.6	−11 48.0	−12 10.2	16 30 41.9	16 30 19.7	16 29 57.9	1 11.9	5	262

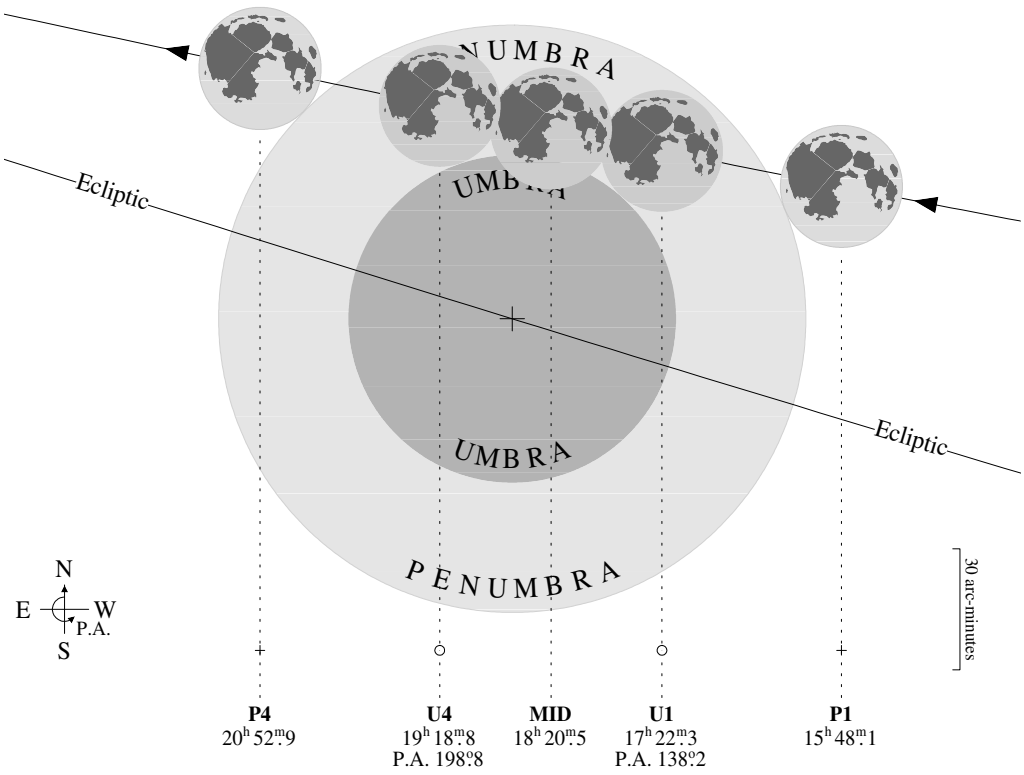
For limits, see Circumstances of the Eclipse.

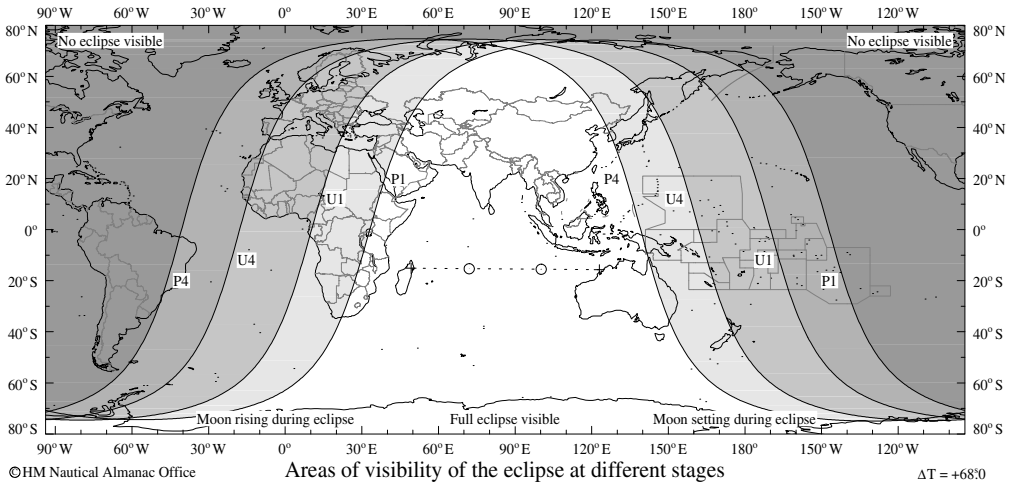
III. - Partial Eclipse of the Moon

2017 August 07

UT of geocentric opposition in RA: August $7^{d}\ 18^{h}\ 40^{m}\ 47\overset{s}{.}676$

Umbral magnitude of the eclipse: 0.252





Areas of visibility of the eclipse at different stages

$\Delta T = +68\overset{s}{.}0$

IV. – Total Eclipse of the Sun, 2017 August 21

CIRCUMSTANCES OF THE ECLIPSE

Universal Time of geocentric conjunction in right ascension, August $21^{d}\ 18^{h}\ 13^{m}\ 13^{s}.898$
Julian Date = 2457987.2591886310

		UT d	h	m	Longitude °	′	Latitude °	′
Eclipse begins	August	21	15	46.8	−153	05.4	+30	32.7
Beginning of southern limit of umbra		21	16	48.8	−171	25.3	+39	27.9
Beginning of center line; central eclipse begins		21	16	49.1	−171	35.2	+39	44.1
Beginning of northern limit of umbra		21	16	49.4	−171	45.2	+40	00.4
Central eclipse at local apparent noon		21	18	13.2	− 92	33.2	+38	55.5
End of northern limit of umbra		21	20	01.9	− 27	19.4	+11	16.3
End of center line; central eclipse ends		21	20	02.1	− 27	26.4	+11	01.1
End of southern limit of umbra		21	20	02.4	− 27	33.4	+10	46.0
Eclipse ends		21	21	04.4	− 44	59.7	+ 1	42.3

BESSELIAN ELEMENTS

Let $t = (\mathrm{UT} - 15^{h}) + \delta T/3600$ in units of hours.

These equations are valid over the range $0^{h}.708 \le t \le 6^{h}.242$. Do not use t outside the given range, and do not omit any terms in the series.

Intersection of the axis of shadow with the fundamental plane:

$$x = -1.74120081 + 0.54060256\,t + 0.00004297\,t^2 - 0.00000809\,t^3$$
$$y = +0.90673122 - 0.14104542\,t - 0.00010886\,t^2 + 0.00000205\,t^3$$

Direction of the axis of shadow:

$$\sin d = +0.20633327 - 0.00023246\,t - 0.00000002\,t^2$$
$$\cos d = +0.97848177 + 0.00004903\,t - 0.00000003\,t^2$$
$$\mu = 44°.23293064 + 15.00392665\,t + 0.00000204\,t^2 - 0.00000005\,t^3 - 0.00417807\,\delta T$$

Radius of the shadow on the fundamental plane:

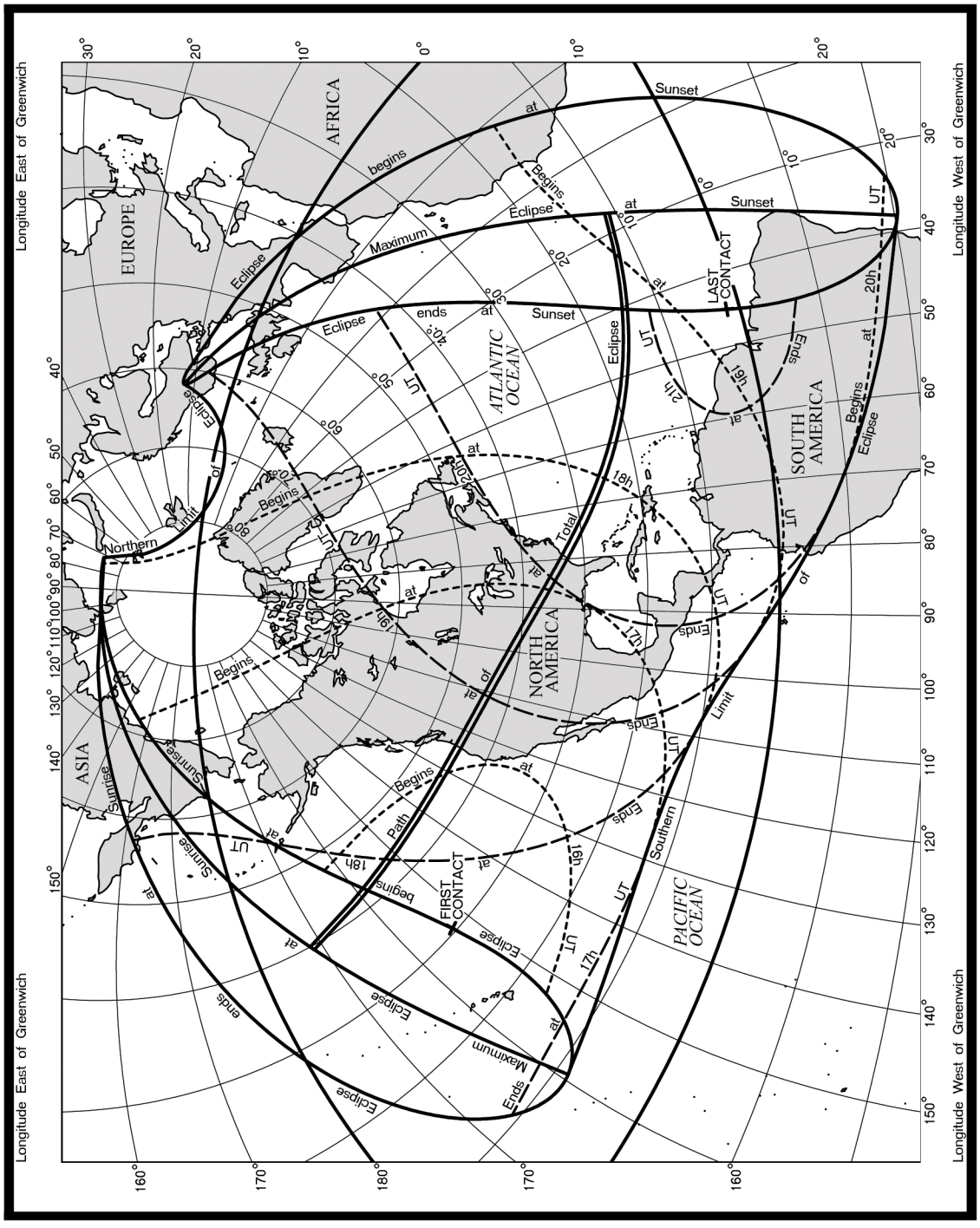
$$\text{penumbra } (l_1) = +0.54164107 + 0.00019430\,t - 0.00001179\,t^2$$
$$\text{umbra } (l_2) = -0.00472086 + 0.00019340\,t - 0.00001175\,t^2$$

Other important quantities:

$$\tan f_1 = +0.004622$$
$$\tan f_2 = +0.004599$$
$$\mu' = +0.261868 \text{ radians per hour}$$
$$d' = -0.000238 \text{ radians per hour}$$

All time arguments are given provisionally in Universal Time, using $\Delta T(A) = 68^{s}.0$.

TOTAL SOLAR ECLIPSE OF 2017 AUGUST 21



PATH OF CENTRAL PHASE: TOTAL SOLAR ECLIPSE OF AUGUST 21

For limits, see Circumstances of the Eclipse.

Longitude	Latitude of: Northern Limit	Central Line	Southern Limit	Universal Time at: Northern Limit	Central Line	Southern Limit	On Central Line: Maximum Duration	Sun's Alt.	Sun's Az.
° ′	° ′	° ′	° ′	h m s	h m s	h m s	m s	°	°
−165 00	+41 24.5	+41 04.5	+40 44.5	16 49 56.5	16 49 37.1	16 49 19.4	1 01.9	5	79
−164 00	+41 36.4	+41 15.9	+40 56.0	16 50 05.5	16 49 47.5	16 49 27.6	1 03.1	6	80
−163 00	+41 47.8	+41 27.3	+41 07.1	16 50 17.2	16 49 58.0	16 49 37.6	1 04.4	7	80
−162 00	+41 59.0	+41 38.4	+41 17.9	16 50 30.9	16 50 10.3	16 49 50.1	1 05.6	8	81
−161 00	+42 10.0	+41 49.1	+41 28.4	16 50 45.6	16 50 24.7	16 50 04.3	1 06.9	9	82
−160 00	+42 20.7	+41 59.6	+41 38.7	16 51 01.8	16 50 40.5	16 50 19.7	1 08.1	9	82
−159 00	+42 31.2	+42 09.9	+41 48.7	16 51 19.4	16 50 57.8	16 50 36.6	1 09.4	10	83
−158 00	+42 41.4	+42 19.9	+41 58.6	16 51 38.5	16 51 16.5	16 50 55.0	1 10.7	11	84
−157 00	+42 51.4	+42 29.7	+42 08.1	16 51 59.0	16 51 36.7	16 51 14.8	1 12.1	12	85
−156 00	+43 01.1	+42 39.2	+42 17.4	16 52 20.9	16 51 58.3	16 51 36.1	1 13.4	13	85
−155 00	+43 10.6	+42 48.4	+42 26.4	16 52 44.3	16 52 21.4	16 51 58.9	1 14.7	13	86
−154 00	+43 19.7	+42 57.4	+42 35.2	16 53 09.2	16 52 45.9	16 52 23.2	1 16.1	14	87
−153 00	+43 28.6	+43 06.1	+42 43.6	16 53 35.5	16 53 12.0	16 52 48.9	1 17.5	15	88
−152 00	+43 37.2	+43 14.5	+42 51.8	16 54 03.3	16 53 39.5	16 53 16.2	1 18.9	16	88
−151 00	+43 45.5	+43 22.6	+42 59.7	16 54 32.5	16 54 08.5	16 53 44.9	1 20.3	17	89
−150 00	+43 53.5	+43 30.4	+43 07.4	16 55 03.2	16 54 39.0	16 54 15.2	1 21.7	17	90
−149 00	+44 01.2	+43 37.9	+43 14.7	16 55 35.4	16 55 11.0	16 54 47.0	1 23.1	18	91
−148 00	+44 08.6	+43 45.1	+43 21.7	16 56 09.0	16 55 44.5	16 55 20.3	1 24.6	19	92
−147 00	+44 15.6	+43 51.9	+43 28.4	16 56 44.2	16 56 19.4	16 55 55.2	1 26.0	20	93
−146 00	+44 22.4	+43 58.5	+43 34.7	16 57 20.8	16 56 55.9	16 56 31.5	1 27.5	21	93
−145 00	+44 28.8	+44 04.8	+43 40.8	16 57 58.9	16 57 34.0	16 57 09.5	1 29.0	22	94
−144 00	+44 34.9	+44 10.7	+43 46.5	16 58 38.5	16 58 13.5	16 57 48.9	1 30.5	22	95
−143 00	+44 40.7	+44 16.2	+43 51.9	16 59 19.6	16 58 54.6	16 58 30.0	1 32.0	23	96
−142 00	+44 46.1	+44 21.5	+43 57.0	17 00 02.2	16 59 37.2	16 59 12.6	1 33.5	24	97
−141 00	+44 51.1	+44 26.4	+44 01.7	17 00 46.4	17 00 21.3	16 59 56.8	1 35.0	25	98
−140 00	+44 55.8	+44 30.9	+44 06.0	17 01 32.0	17 01 07.1	17 00 42.5	1 36.6	26	99
−139 00	+45 00.2	+44 35.1	+44 10.0	17 02 19.2	17 01 54.3	17 01 29.9	1 38.1	27	100
−138 00	+45 04.2	+44 38.9	+44 13.7	17 03 07.9	17 02 43.2	17 02 18.9	1 39.7	27	101
−137 00	+45 07.8	+44 42.3	+44 17.0	17 03 58.2	17 03 33.6	17 03 09.5	1 41.3	28	102
−136 00	+45 11.0	+44 45.4	+44 19.8	17 04 50.1	17 04 25.7	17 04 01.7	1 42.8	29	103
−135 00	+45 13.9	+44 48.1	+44 22.4	17 05 43.5	17 05 19.3	17 04 55.6	1 44.4	30	104
−134 00	+45 16.4	+44 50.4	+44 24.5	17 06 38.5	17 06 14.6	17 05 51.2	1 46.0	31	105
−133 00	+45 18.4	+44 52.3	+44 26.2	17 07 35.1	17 07 11.5	17 06 48.4	1 47.7	32	106
−132 00	+45 20.1	+44 53.8	+44 27.5	17 08 33.3	17 08 10.1	17 07 47.4	1 49.3	32	107
−131 00	+45 21.3	+44 54.9	+44 28.4	17 09 33.1	17 09 10.4	17 08 48.0	1 50.9	33	108
−130 00	+45 22.2	+44 55.5	+44 28.9	17 10 34.6	17 10 12.3	17 09 50.4	1 52.5	34	109
−129 00	+45 22.6	+44 55.8	+44 29.0	17 11 37.7	17 11 15.9	17 10 54.5	1 54.2	35	110
−128 00	+45 22.6	+44 55.6	+44 28.7	17 12 42.6	17 12 21.3	17 12 00.4	1 55.8	36	111
−127 00	+45 22.2	+44 55.0	+44 27.9	17 13 49.1	17 13 28.4	17 13 08.1	1 57.5	37	112
−126 00	+45 21.3	+44 53.9	+44 26.6	17 14 57.3	17 14 37.3	17 14 17.6	1 59.1	37	113
−125 00	+45 19.9	+44 52.4	+44 24.9	17 16 07.3	17 15 47.9	17 15 29.0	2 00.8	38	115
−124 00	+45 18.1	+44 50.4	+44 22.8	17 17 19.0	17 17 00.4	17 16 42.2	2 02.5	39	116
−123 00	+45 15.8	+44 48.0	+44 20.1	17 18 32.5	17 18 14.7	17 17 57.3	2 04.1	40	117
−122 00	+45 13.1	+44 45.0	+44 17.0	17 19 47.8	17 19 30.9	17 19 14.3	2 05.8	41	118
−121 00	+45 09.9	+44 41.6	+44 13.4	17 21 05.0	17 20 48.9	17 20 33.3	2 07.4	42	120
−120 00	+45 06.1	+44 37.7	+44 09.3	17 22 24.0	17 22 08.9	17 21 54.2	2 09.1	43	121
−119 00	+45 01.9	+44 33.3	+44 04.7	17 23 44.9	17 23 30.8	17 23 17.2	2 10.7	43	122
−118 00	+44 57.2	+44 28.4	+43 59.6	17 25 07.7	17 24 54.7	17 24 42.2	2 12.4	44	124
−117 00	+44 51.9	+44 22.9	+43 53.9	17 26 32.5	17 26 20.6	17 26 09.2	2 14.0	45	125
−116 00	+44 46.1	+44 16.9	+43 47.8	17 27 59.3	17 27 48.6	17 27 38.4	2 15.7	46	127

PATH OF CENTRAL PHASE: TOTAL SOLAR ECLIPSE OF AUGUST 21

Longitude	Latitude of: Northern Limit	Central Line	Southern Limit	Universal Time at: Northern Limit	Central Line	Southern Limit	On Central Line: Maximum Duration	Sun's Alt.	Sun's Az.
° ′	° ′	° ′	° ′	h m s	h m s	h m s	m s	°	°
−115 00	+44 39.8	+44 10.4	+43 41.0	17 29 28.0	17 29 18.6	17 29 09.7	2 17.3	47	128
−114 00	+44 32.9	+44 03.3	+43 33.7	17 30 58.8	17 30 50.7	17 30 43.1	2 18.9	48	130
−113 00	+44 25.4	+43 55.7	+43 25.9	17 32 31.7	17 32 25.0	17 32 18.8	2 20.5	49	131
−112 00	+44 17.4	+43 47.4	+43 17.4	17 34 06.7	17 34 01.4	17 33 56.7	2 22.0	49	133
−111 00	+44 08.8	+43 38.6	+43 08.4	17 35 43.9	17 35 40.1	17 35 36.8	2 23.6	50	134
−110 00	+43 59.6	+43 29.2	+42 58.7	17 37 23.2	17 37 21.0	17 37 19.3	2 25.1	51	136
−109 00	+43 49.8	+43 19.1	+42 48.5	17 39 04.7	17 39 04.2	17 39 04.1	2 26.6	52	138
−108 00	+43 39.4	+43 08.5	+42 37.6	17 40 48.6	17 40 49.7	17 40 51.4	2 28.1	53	140
−107 00	+43 28.3	+42 57.2	+42 26.0	17 42 34.7	17 42 37.5	17 42 41.0	2 29.5	53	142
−106 00	+43 16.6	+42 45.2	+42 13.9	17 44 23.1	17 44 27.8	17 44 33.1	2 30.9	54	144
−105 00	+43 04.2	+42 32.6	+42 01.0	17 46 13.9	17 46 20.4	17 46 27.6	2 32.3	55	146
−104 00	+42 51.2	+42 19.3	+41 47.5	17 48 07.0	17 48 15.6	17 48 24.7	2 33.6	56	148
−103 00	+42 37.5	+42 05.4	+41 33.2	17 50 02.6	17 50 13.2	17 50 24.3	2 34.8	57	150
−102 00	+42 23.0	+41 50.7	+41 18.3	17 52 00.7	17 52 13.3	17 52 26.5	2 36.0	57	153
−101 00	+42 07.9	+41 35.3	+41 02.7	17 54 01.2	17 54 15.9	17 54 31.3	2 37.2	58	155
−100 00	+41 52.1	+41 19.2	+40 46.3	17 56 04.2	17 56 21.1	17 56 38.7	2 38.3	59	158
− 99 00	+41 35.5	+41 02.4	+40 29.2	17 58 09.8	17 58 28.9	17 58 48.7	2 39.3	60	160
− 98 00	+41 18.2	+40 44.8	+40 11.3	18 00 17.9	18 00 39.2	18 01 01.3	2 40.3	60	163
− 97 00	+41 00.1	+40 26.4	+39 52.7	18 02 28.5	18 02 52.1	18 03 16.5	2 41.1	61	166
− 96 00	+40 41.3	+40 07.3	+39 33.3	18 04 41.7	18 05 07.6	18 05 34.3	2 41.9	61	169
− 95 00	+40 21.7	+39 47.4	+39 13.2	18 06 57.3	18 07 25.7	18 07 54.8	2 42.6	62	172
− 94 00	+40 01.3	+39 26.8	+38 52.2	18 09 15.5	18 09 46.2	18 10 17.7	2 43.2	62	175
− 93 00	+39 40.1	+39 05.4	+38 30.5	18 11 36.2	18 12 09.3	18 12 43.2	2 43.7	63	178
− 92 00	+39 18.2	+38 43.1	+38 08.0	18 13 59.4	18 14 34.8	18 15 11.1	2 44.1	63	182
− 91 00	+38 55.5	+38 20.1	+37 44.7	18 16 24.9	18 17 02.7	18 17 41.4	2 44.4	63	185
− 90 00	+38 31.9	+37 56.3	+37 20.7	18 18 52.7	18 19 33.0	18 20 14.0	2 44.6	64	189
− 89 00	+38 07.6	+37 31.7	+36 55.8	18 21 22.8	18 22 05.4	18 22 48.7	2 44.6	64	193
− 88 00	+37 42.5	+37 06.4	+36 30.2	18 23 55.1	18 24 40.0	18 25 25.5	2 44.6	64	197
− 87 00	+37 16.6	+36 40.3	+36 03.9	18 26 29.4	18 27 16.5	18 28 04.3	2 44.3	64	201
− 86 00	+36 50.0	+36 13.4	+35 36.8	18 29 05.6	18 29 54.8	18 30 44.8	2 44.0	64	204
− 85 00	+36 22.6	+35 45.8	+35 09.0	18 31 43.5	18 32 34.8	18 33 26.8	2 43.5	64	208
− 84 00	+35 54.6	+35 17.5	+34 40.5	18 34 23.0	18 35 16.3	18 36 10.2	2 42.9	63	212
− 83 00	+35 25.8	+34 48.6	+34 11.4	18 37 03.8	18 37 59.1	18 38 54.8	2 42.1	63	216
− 82 00	+34 56.3	+34 19.0	+33 41.6	18 39 45.8	18 40 42.8	18 41 40.2	2 41.2	63	219
− 81 00	+34 26.2	+33 48.7	+33 11.3	18 42 28.8	18 43 27.3	18 44 26.3	2 40.2	62	223
− 80 00	+33 55.5	+33 17.9	+32 40.4	18 45 12.3	18 46 12.4	18 47 12.6	2 39.0	61	226
− 79 00	+33 24.3	+32 46.6	+32 09.0	18 47 56.3	18 48 57.6	18 49 59.1	2 37.7	61	230
− 78 00	+32 52.5	+32 14.8	+31 37.2	18 50 40.3	18 51 42.7	18 52 45.3	2 36.2	60	233
− 77 00	+32 20.3	+31 42.6	+31 05.0	18 53 24.1	18 54 27.5	18 55 30.8	2 34.6	59	236
− 76 00	+31 47.7	+31 10.0	+30 32.4	18 56 07.4	18 57 11.5	18 58 15.5	2 32.9	58	239
− 75 00	+31 14.8	+30 37.1	+29 59.6	18 58 49.8	18 59 54.5	19 00 58.9	2 31.1	57	242
− 74 00	+30 41.6	+30 04.0	+29 26.6	19 01 31.1	19 02 36.0	19 03 40.7	2 29.1	56	244
− 73 00	+30 08.1	+29 30.7	+28 53.4	19 04 10.8	19 05 15.9	19 06 20.6	2 27.1	55	247
− 72 00	+29 34.5	+28 57.2	+28 20.2	19 06 48.7	19 07 53.8	19 08 58.4	2 24.9	54	249
− 71 00	+29 00.8	+28 23.7	+27 46.9	19 09 24.4	19 10 29.3	19 11 33.5	2 22.7	53	251
− 70 00	+28 27.0	+27 50.2	+27 13.7	19 11 57.7	19 13 02.1	19 14 05.9	2 20.4	51	253
− 69 00	+27 53.3	+27 16.8	+26 40.5	19 14 28.2	19 15 32.1	19 16 35.2	2 18.0	50	255
− 68 00	+27 19.7	+26 43.5	+26 07.5	19 16 55.8	19 17 58.9	19 19 01.2	2 15.5	49	257
− 67 00	+26 46.2	+26 10.4	+25 34.8	19 19 20.0	19 20 22.3	19 21 23.7	2 13.0	48	258
− 66 00	+26 12.9	+25 37.5	+25 02.3	19 21 40.8	19 22 42.1	19 23 42.4	2 10.5	46	260

PATH OF CENTRAL PHASE: TOTAL SOLAR ECLIPSE OF AUGUST 21

Longitude	Latitude of: Northern Limit	Central Line	Southern Limit	Universal Time at: Northern Limit	Central Line	Southern Limit	On Central Line: Maximum Duration	Sun's Alt.	Sun's Az.
° ′	° ′	° ′	° ′	h m s	h m s	h m s	m s	°	°
− 65 00	+25 39.9	+25 04.9	+24 30.1	19 23 57.9	19 24 58.0	19 25 57.2	2 07.9	45	261
− 64 00	+25 07.2	+24 32.6	+23 58.3	19 26 11.1	19 27 10.0	19 28 07.9	2 05.3	44	263
− 63 00	+24 34.9	+24 00.7	+23 26.8	19 28 20.3	19 29 17.9	19 30 14.4	2 02.7	42	264
− 62 00	+24 02.9	+23 29.2	+22 55.8	19 30 25.4	19 31 21.6	19 32 16.7	2 00.1	41	265
− 61 00	+23 31.4	+22 58.2	+22 25.3	19 32 26.2	19 33 20.9	19 34 14.5	1 57.5	40	266
− 60 00	+23 00.4	+22 27.7	+21 55.3	19 34 22.7	19 35 15.9	19 36 08.0	1 54.9	38	267
− 59 00	+22 29.8	+21 57.6	+21 25.7	19 36 14.8	19 37 06.5	19 37 57.0	1 52.3	37	268
− 58 00	+21 59.8	+21 28.1	+20 56.8	19 38 02.5	19 38 52.6	19 39 41.6	1 49.7	36	269
− 57 00	+21 30.3	+20 59.2	+20 28.3	19 39 45.7	19 40 34.2	19 41 21.7	1 47.2	34	270
− 56 00	+21 01.3	+20 30.8	+20 00.5	19 41 24.5	19 42 11.5	19 42 57.3	1 44.7	33	271
− 55 00	+20 33.0	+20 02.9	+19 33.2	19 42 58.9	19 43 44.3	19 44 28.6	1 42.2	32	272
− 54 00	+20 05.2	+19 35.7	+19 06.5	19 44 28.9	19 45 12.7	19 45 55.5	1 39.7	31	272
− 53 00	+19 38.0	+19 09.1	+18 40.4	19 45 54.5	19 46 36.8	19 47 18.1	1 37.3	29	273
− 52 00	+19 11.4	+18 43.0	+18 15.0	19 47 15.9	19 47 56.6	19 48 36.4	1 34.9	28	274
− 51 00	+18 45.4	+18 17.6	+17 50.1	19 48 33.0	19 49 12.2	19 49 50.5	1 32.6	27	274
− 50 00	+18 20.1	+17 52.8	+17 25.8	19 49 45.9	19 50 23.7	19 51 00.6	1 30.3	25	275
− 49 00	+17 55.3	+17 28.6	+17 02.1	19 50 54.8	19 51 31.1	19 52 06.6	1 28.0	24	275
− 48 00	+17 31.1	+17 04.9	+16 39.0	19 51 59.6	19 52 34.6	19 53 08.7	1 25.8	23	276
− 47 00	+17 07.6	+16 41.9	+16 16.5	19 53 00.6	19 53 34.2	19 54 07.0	1 23.6	22	276
− 46 00	+16 44.6	+16 19.5	+15 54.6	19 53 57.6	19 54 29.9	19 55 01.4	1 21.5	20	277
− 45 00	+16 22.3	+15 57.6	+15 33.2	19 54 51.0	19 55 22.0	19 55 52.3	1 19.4	19	277
− 44 00	+16 00.5	+15 36.4	+15 12.5	19 55 40.7	19 56 10.5	19 56 39.5	1 17.4	18	278
− 43 00	+15 39.3	+15 15.7	+14 52.3	19 56 26.8	19 56 55.4	19 57 23.3	1 15.4	17	278
− 42 00	+15 18.6	+14 55.5	+14 32.7	19 57 09.4	19 57 36.9	19 58 03.7	1 13.5	16	278
− 41 00	+14 58.6	+14 36.0	+14 13.6	19 57 48.7	19 58 15.1	19 58 40.8	1 11.6	15	279
− 40 00	+14 39.1	+14 16.9	+13 55.0	19 58 24.7	19 58 50.0	19 59 14.7	1 09.7	13	279
− 39 00	+14 20.1	+13 58.5	+13 37.0	19 58 57.5	19 59 21.8	19 59 45.4	1 07.9	12	279
− 38 00	+14 01.7	+13 40.5	+13 19.5	19 59 27.2	19 59 50.4	20 00 13.1	1 06.1	11	280
− 37 00	+13 43.8	+13 23.1	+13 02.5	19 59 53.8	20 00 16.2	20 00 37.9	1 04.4	10	280
− 36 00	+13 26.4	+13 06.2	+12 46.1	20 00 17.5	20 00 39.0	20 00 59.8	1 02.7	9	280
− 35 00	+13 09.6	+12 49.8	+12 30.1	20 00 38.5	20 00 58.9	20 01 19.1	1 01.1	8	280
− 34 00	+12 53.2	+12 33.7	+12 14.8	20 00 56.5	20 01 16.7	20 01 34.5	0 59.4	7	281
− 33 00	+12 37.7	+12 18.5	+11 59.9	20 01 10.3	20 01 30.5	20 01 47.5	0 57.9	6	281

For limits, see Circumstances of the Eclipse.

Joint publications of HM Nautical Almanac Office (UKHO) and the United States Naval Observatory

These publications are available from UKHO Distributors and the Superintendent of Documents, U.S. Government Printing Office (USGPO) except where noted.

The Astronomical Almanac (AsA) and *The Astronomical Almanac Online* (AsA Online) contain ephemerides of the Sun, Moon, planets and their natural satellites, as well as data on eclipses and other astronomical phenomena. The AsA is an annual volume while AsA Online is updated annually. The data are calculated cooperatively by the British and American offices. A full list of contributors is given on page vii of the AsA (UKHO GP100) and on AsA Online.

The Nautical Almanac contains ephemerides at an interval of one hour and auxiliary astronomical data for marine navigation. (UKHO NP314)

The Air Almanac contains ephemerides at an interval of ten minutes and auxiliary astronomical data for air navigation. This publication is now distributed solely on CD-ROM and is only available from USGPO.

Rapid Sight Reduction Tables for Navigation (AP 3270 / NP 303), 3 volumes, formerly entitled *Sight Reduction Tables for Air Navigation*. Volume 1, selected stars for epoch 2015·0, containing the altitude to $1'$ and true azimuth to 1° for the seven stars most suitable for navigation, for all latitudes and hour angles of Aries.

Other publications of HM Nautical Almanac Office (UKHO)

The Star Almanac for Land Surveyors (NP 321) contains the Greenwich hour angle of Aries and the position of the Sun, tabulated for every six hours, and represented by monthly polynomial coefficients. Positions of all stars brighter than magnitude 4·0 are tabulated monthly to a precision of $0^s.1$ in right ascension and $1''$ in declination. A CD-ROM is included which contains the electronic edition plus coefficients, in ASCII format, representing the data.

NavPac and Compact Data for 2011–2015 (DP 330) contains software, algorithms and data, which are mainly in the form of polynomial coefficients, for calculating the positions of the Sun, Moon, navigational planets and bright stars. It enables navigators to compute their position at sea from sextant observations using Windows OS XP/Vista/7/8 for the period 1986–2015. The tabular data are also supplied as ASCII files on the CD-ROM. The website http://astro.ukho.gov.uk/nao/navpac/ provides a home for issues related to NavPac including the upcoming edition for 2016-2020.

Planetary and Lunar Coordinates, 2001–2020 provides low-precision astronomical data and phenomena for use well in advance of the annual ephemerides. It contains heliocentric, geocentric, spherical and rectangular coordinates of the Sun, Moon and planets, eclipse maps and auxiliary data. All the tabular ephemerides are supplied solely on CD-ROM as ASCII and Adobe's portable document format files. The full printed edition is published in the United States by Willmann-Bell Inc, PO Box 35025, Richmond VA 23235, USA.

Rapid Sight Reduction Tables for Navigation (AP 3270 / NP 303), 3 volumes, formerly entitled *Sight Reduction Tables for Air Navigation*. Volumes 2 and 3 contain altitudes to $1'$ and azimuths to 1° for integral degrees of declination from N 29° to S 29°, for relevant latitudes and all hour angles at which the zenith distance is less than 95° providing for sights of the Sun, Moon and planets.

The UK Air Almanac (AP1602) contains data useful in the planning of activities where the level of illumination is important, particularly aircraft movements, and is produced to the general requirements of the Royal Air Force. It may be downloaded from the website http://astro.ukho.gov.uk/nao/publicat/ukaa.html.

NAO Technical Notes are issued irregularly to disseminate astronomical data concerning ephemerides or astronomical phenomena.

Other publications of the United States Naval Observatory

Astronomical Papers of the American Ephemeris† are issued irregularly and contain reports of research in celestial mechanics with particular relevance to ephemerides.

U.S. Naval Observatory Circulars† are issued irregularly to disseminate astronomical data concerning ephemerides or astronomical phenomena.

U.S. Naval Observatory Circular No. 179, The IAU Resolutions on Astronomical Reference Systems, Time Scales, and Earth Rotation Models explains resolutions and their effects on the data (see Web Links).

Explanatory Supplement to The Astronomical Almanac, (3rd edition). This book is an authoritative source on the basis and derivation of information contained in *The Astronomical Almanac*. It contains material that is relevant to positional and dynamical astronomy and to chronology. The publication is a collaborative work with authors from the U.S. Naval Observatory, H.M. Nautical Almanac Office, the Jet Propulsion Laboratory, and others. This edition is published by and available from University Science Books, whose UK distributor is Palgrave Macmillan.

MICA is an interactive astronomical almanac for professional applications. Software for both PC systems with Intel processors and Apple Macintosh computers is provided on a single CD-ROM. *MICA* allows a user to compute, to full precision, much of the tabular data contained in *The Astronomical Almanac*, as well as data for specific times and locations. All calculations are made in real time and data are not interpolated from tables. MICA is a product of the U.S. Naval Observatory; it is published by and available from Willmann-Bell Inc. The latest version covers the interval 1800-2050.

† Many of these publications are available from the Nautical Almanac Office, U.S. Naval Observatory, Washington, DC 20392-5420, see Web Links on the next page for availability.

Publications of other countries

Apparent Places of Fundamental Stars is prepared by the Astronomisches Rechen-Institut, Heidelberg (http://www.ari.uni-heidelberg.de). The printed version of APFS gives the data for a few fundamental stars only, together with the explanation and examples. The apparent places of stars using the FK6 or Hipparcos catalogues are provided by the on-line database ARIAPFS (http://wwwadd.zah.uni-heidelberg.de/datenbanken/ariapfs/). The printed booklet also contains the so-called '10-Day-Stars' and the 'Circumpolar Stars' and is available from G. Braun Buchverlag, Erbprinzenstrasse 4 - 12, 76133 Karlsruhe, Germany.

Ephemerides of Minor Planets is prepared annually by the Institute of Applied Astronomy (http://www.ipa.nw.ru), and published by the Russian Academy of Sciences. Included in this volume are elements, opposition dates and opposition ephemerides of all numbered minor planets. This volume (http://www.ipa.nw.ru/PAGE/DEPFUND/LSBSS/engephem.htm) is available from the Institute of Applied Astronomy, Naberezhnaya Kutuzova 10, St. Petersburg, 191187 Russia.

Electronic Publications

The Astronomical Almanac Online: The companion publication of *The Astronomical Almanac*, providing data best presented in machine-readable form. It typically does not duplicate the data from the book. It does, in some cases, provide additional information or greater precision than the printed data. Examples of data found on *The Astronomical Almanac Online* are searchable databases, eclipse and occultation maps, errata found in the printed publication, and a searchable glossary. It is available at

http://asa.usno.navy.mil — WWW — http://asa.hmnao.com

Please refer to the relevant World Wide Web address for further details about the publications and services provided by the following organisations.

U.S. Naval Observatory

- U.S. Naval Observatory portal at http://www.usno.navy.mil/USNO
- USNO Astronomical Applications Department portal at http://aa.usno.navy.mil/
- USNO Data Services at http://aa.usno.navy.mil/data/
- NOVAS astrometry software at http://aa.usno.navy.mil/software/novas/
- *USNO Circular 179* at http://aa.usno.navy.mil/publications/docs/Circular_179.php
- *The Astronomical Almanac Online*—WWW— at http://asa.usno.navy.mil

H.M. Nautical Almanac Office

- General information at http://astro.ukho.gov.uk
- *The Astronomical Almanac Online*—WWW— at http://asa.hmnao.com/
- Eclipses Online at http://astro.ukho.gov.uk/eclipse/
- Online data services at http://astro.ukho.gov.uk/websurf/
- Crescent MoonWatch at http://astro.ukho.gov.uk/moonwatch/

International Astronomical Organizations

- IAU: International Astronomical Union at http://www.iau.org
- IERS: International Earth Rotation and Reference Systems Service at http://www.iers.org
- SOFA: IAU Standards of Fundamental Astronomy at http://www.iausofa.org
- NSFA: IAU Working Group on Numerical Standards at http://maia.usno.navy.mil/NSFA/
- CDS: Centre de Données astronomiques de Strasbourg at http://cdsweb.u-strasbg.fr

Publishers and Suppliers

- The UK Hydrographic Office (UKHO) at http://www.ukho.gov.uk
- U.S. Government Printing Office (USGPO) at http://bookstore.gpo.gov
- University Science Books at http://www.uscibooks.com
- Willmann-Bell at http://www.willbell.com
- Macmillan Distribution at http://www.palgrave.com